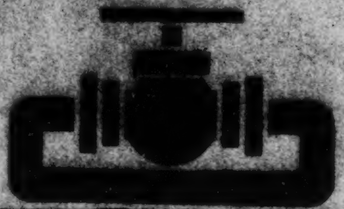

A Guide to Sour Gas Development and Land Use Planning in the Calgary Region

Calgary Regional Planning Commission [illegible]
Calgary, [illegible]
[illegible]

A GUIDE TO SOUR GAS DEVELOPMENT AND LAND USE PLANNING WITHIN THE CALGARY REGION

Calgary Regional Planning Commission

September, 1987

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FOREWORD

The principle objective of this guideline document is to provide general information on the sour gas industry within the Region. Given the level of sour gas development within the Region and the number of potential conflict zones already existing, the question is not which use is a priority but whether co-existence of resource development and urban or rural development can be achieved over time. Problems have arisen as a result of development taking place without liaison between municipalities, industry, regional planning commissions and the ERCB. That is, a co-ordinated effort and effective information exchange is the first step toward reasonable co-existence and the best way to ensure that municipal interests are maintained. It is hoped that the information in this document will assist in minimizing potential conflicts between land use development and the sour gas industry.

These guidelines are intended to be used together with the Sour Gas Study of the Calgary Region, produced by the Calgary Regional Planning Commission. The technical study provides a good introduction to the sour gas industry in the Calgary Region and outlines some of the issues and deficiencies related to planning around sour gas development.

This document provides supplementary information on matters that were raised in the Sour Gas Study and is aimed at municipal councillors, development officers and planners. Because sour gas is an important and extensive industry within our Region, this handbook was designed to give these audiences additional insight into the industry.

It should be stressed that this report is intended to provide a compendium of background information and is aimed largely at a technical audience and at decision makers who are required to deal with the technical aspects of land use and sour gas conflict issues.

EXECUTIVE SUMMARY

This Guide to Sour Gas Development and Land Use Planning Within the Calgary Region, focuses on a variety of important points. These are summarized as follows:

1. In the Calgary Region, large natural gas reserves underlie most of the land. More than half of the proven gas reserves in the Calgary Region and immediate vicinity are sour.

2. It is calculated that the Calgary Region will provide approximately 10-15% of the total sour gas and 30% of the sulphur production in Alberta. This represents a significant portion of the total provincial sour gas resource.

3. The future of the natural gas market in Alberta is influenced by three major factors:

   (a) the continued exploration and development of reserves;

   (b) the ability to continue to produce gas from known reserves; and

   (c) the regulations applied by the Energy Resources Conservation Board and the Provincial Government to the extraction of the resource in Alberta; and the National Energy Board and the Federal Government in export sales for the product.

   The amount of sour natural gas that is currently produced, and will be produced in the future, is similarly affected by these factors.

4. The guidelines and legislation imposed on wells, pipelines and sour gas processing plants are comprehensive and address all phases, from the initial licence to detailed inspection and monitoring of all aspects of the facility as well as the environment.

5. The ERCB and Alberta Environment play the key roles in monitoring and inspection.

6. In general, nuisance problems such as noise and odor are inconsequential. The number of nuisance complaints in the Region are relatively low in comparison to the level and extent of development.

7. The Subdivision Regulation only requires the ERCB to submit comments on subdivision applications when contacted by the subdivision approving authority. The ERCB advises on the location and classification of a sour gas facility, that is the facility level rating, and may make recommendations concerning safety measures and setback distances in addition to regulations specified in Schedule 6 of the Subdivision Regulation.

8. The ERCB has devised appropriate separation distances from each sour gas facility. These guidelines are essentially the same as those contained within the Planning Act for development setbacks from sour gas facilities.

9. Where no subdivision is involved, the owner/developer may approach the local municipality for the necessary development and building permits and/or change of land use classification approval in accordance with procedures established in the local land use bylaw. This system of land use control takes into consideration the present land use, existing zoning and the suitability of the property to accommodate the proposed development. Where the location of sour gas reserves or facilities is known to be in conflict with the owner's proposed development, then the regulations of Schedule 6 of the Subdivision Regulations of the Planning Act may be put into effect. (See Appendix 3.)

However, this is solely at the discretion of the development approval authority. Unlike subdivision approvals, the Planning Act does not require development permit approvals to respect separation distances as outlined in Schedule 6 of the Subdivision Regulation.

10. However, information pertaining to potential sour gas reserve areas and proposed sour gas facilities is not always readily available to the particular approving authority. Approvals for land use change or development permits may be granted in the absence of this information. Unknowingly then, the plans of surface owners may conflict with the sour gas industry.

11. The Provincial Government has recognized that the rapid and efficient depletion of energy resources is critical. It is in the public interest to recover as much of the resources as possible, as quickly as possible.

12. Despite the incentive to quickly deplete resources, urban and rural land uses have grown and changed and specific land use conflict areas have emerged.

13. Given the level of sour gas development within the Region and the number of potential conflict zones already existing, the question is no longer that of which use is a priority but whether co-existence of resource development and urban or rural development can be achieved over time.

14. With regard to planning around existing or future sour gas facilities, the municipality has a responsibility to both its residents and to the operator. Firstly, it is the municipality's responsibility to provide additional safeguards for the community against the possible dangers of the sour gas industry. This can be accomplished by integrating the existing process, as set out by Provincial guidelines and regulations, into the municipal planning and development

process. Secondly, in order to ensure a reasonable co-existence, the municipality also has the responsibility of informing the operator of future municipal plans that may create conflict, providing reasonable suggestions to minimize existing conflicts and, where pipeline rights-of-way or well leases exist within incorporated boundaries, ensuring that the potential for third party damage is minimized.

15. The best way to ensure that municipal interests are maintained is through effective communication between the municipality, operator, Regional Planning Commission and ERCB.

1.0 INTRODUCTION

1.1 WHAT IS SOUR GAS

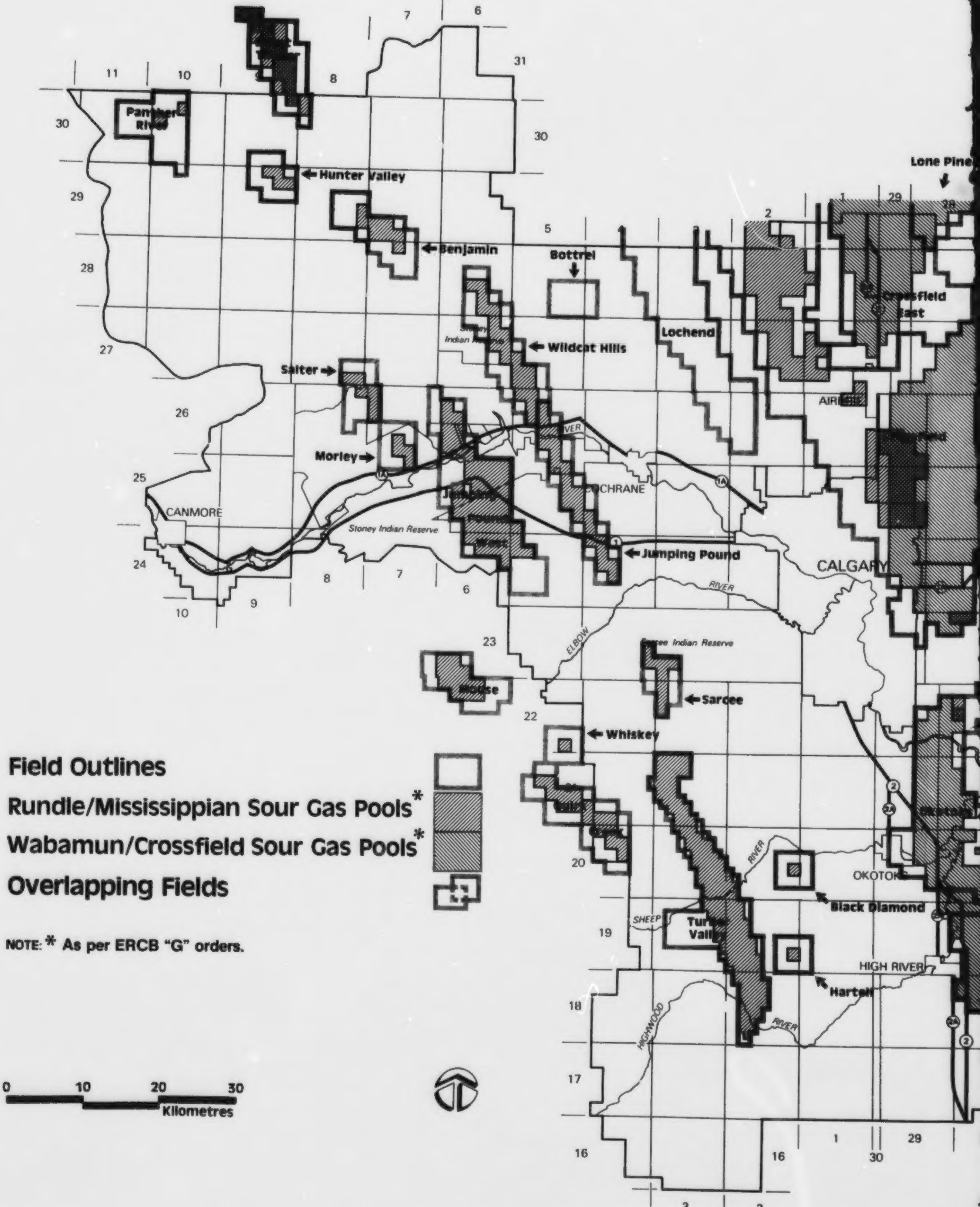
In general terms, natural gas can be categorized in two varieties, sweet and sour. Sour gas contains hydrogen sulphide (H_2S) and requires special equipment and regulations. The hydrogen sulphide concentration in sour gas varies, when highly concentrated it is dangerous and odourless. In lesser concentrations, it is potentially hazardous and has an easily recognizable "rotten egg" smell. The hydrogen sulphide is removed from the gas at gas processing plants in order to make the gas marketable for domestic use.

Regardless of the hydrogen sulphide characteristic, the liquid content of the gas contains other marketable by-products such as propane, butane and ethane. These by-products provide additional benefits and wherever natural gas occurs with a high liquid content, that gas is an attractive resource.

1.2 INVENTORY OF THE SOUR GAS RESERVES IN THE CALGARY REGION

In the Calgary Region, large natural gas reserves underlie most of the land. More than half the proven gas reserves in the Calgary Region and immediate vicinity are sour. There are currently 11 sour gas processing plants within the Region's boundary and a total of 40 throughout Alberta.

The Foothills area is characterised by higher hydrogen sulphide content gas, where concentrations as high as 75-95% have been identified. The eastern half of the Region contains sweet gas reserves. This is clearly illustrated in Figure 1 which shows both sweet and sour proven gas reserves in the Calgary Region.


Panther River
Hunter Valley
Benjamin
Bottrel
Lochend
Lone Pine
Crossfield East
Wildcat Hills
Stoney Indian Reserve
Salter
Morley
CANMORE
COCHRANE
AIRDRIE
Jumping Pound West
Jumping Pound
Stoney Indian Reserve
CALGARY
RIVER
ELBOW
Sarcee Indian Reserve
Sarcee
Moose
Whiskey
RIVER
OKOTOKS
Black Diamond
SHEEP
Turner Valley
HIGH RIVER
Hartell
HIGHWOOD
RIVER
1A
1
2
2A
11
10
8
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31
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25
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23
22
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19
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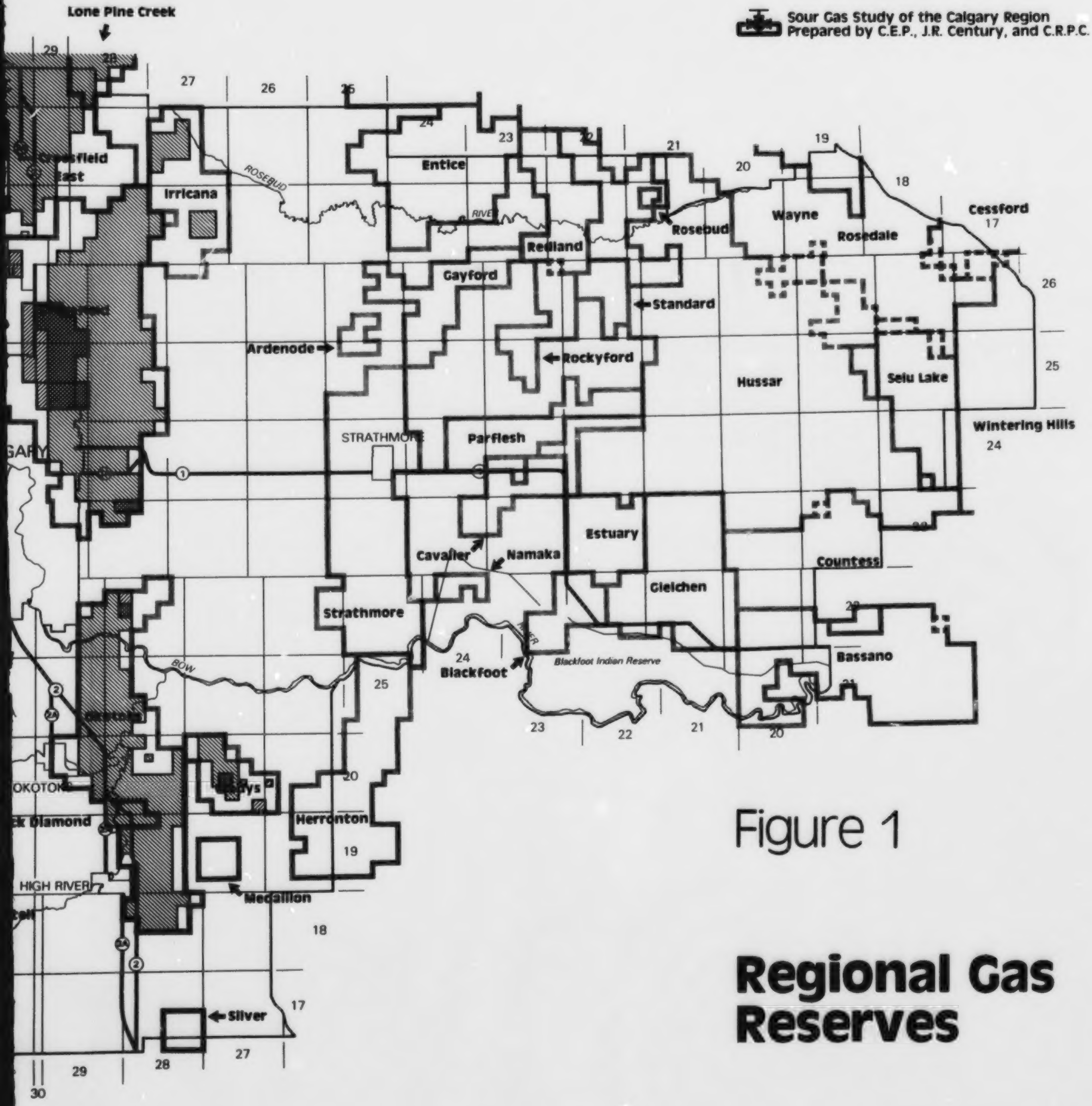
17
16
3
2
1
30
29
5
Field Outlines
Rundle/Mississippian Sour Gas Pools*
Wabamun/Crossfield Sour Gas Pools*
Overlapping Fields
0
10
20
30
Kilometres

NOTE: * As per ERCB "G" orders.

Sour Gas Study of the Calgary Region
Prepared by C.E.P., J.R. Century, and C.R.P.C.


Lone Pine Creek
29
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25
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Crossfield East
Irricana
ROSEBUD RIVER
Entice
Redland
Rosebud
Wayne
Rosedale
Cessford
Gayford
Standard
Ardenode
Rockyford
Hussar
Seiu Lake
Wintering Hills
STRATHMORE
Parflesh
Estuary
Cavalier
Namaka
Countess
Gleichen
Strathmore
BOW RIVER
Blackfoot
Blackfoot Indian Reserve
Bassano
25
24
23
22
21
20
20
19
18
17
Herronton
Medallion
Silver
OKOTOKS
HIGH RIVER
29
28
27
30

Figure 1

Regional Gas Reserves

Sour gas pools are present in the central and western parts of the Region, while the eastern half is underlain by sweet gas fields. The depth of sour gas producing formations range from 2300 - 2650 m (7500 - 8700 ft.) in the vicinity of the City of Calgary to approximately 1920 - 4540 m (6300 - 14,900 ft.) in the foothills areas. Seismic exploration has been responsible for discovering most of the sour gas in the Region. As new exploration tools develop, additional sour gas reserves can be expected to be discovered.

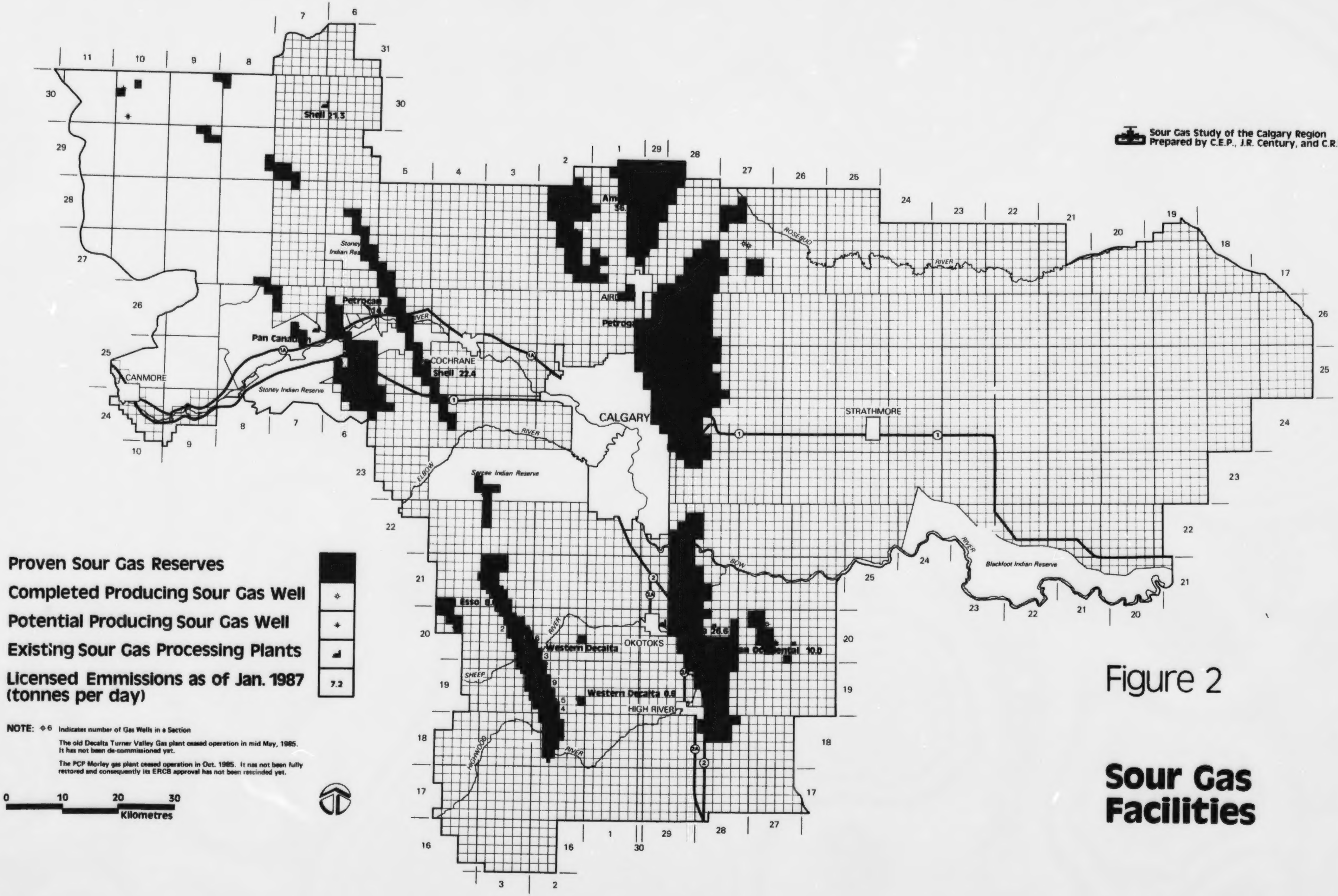
1.3 EXISTING SOUR GAS FACILITIES IN THE CALGARY REGION

The maps in Appendix 1 of this report illustrate the individual operating sour gas facility systems (pipelines) in the Region. The information on location of facility and pipeline facility level ratings was obtained from the ERCB. A facility level rating is the ERCB system of identifying certain levels of H_2S concentration related to sour gas facilities and their capability to release hydrogen sulphide. This will be discussed in greater detail in Section 8.2 of this report. Figure 2 provides a general overview of the various sour gas wells and plants within the Region.

1.4 THE SOUR GAS MARKET

The decision to produce natural gas is enhanced by the liquid content of the gas. The liquid content contains marketable by-products such as propane, butane and ethane. Natural gas with a high liquid content is a most attractive resource as it can provide these additional marketable by-products.

Based upon known and potential reserves, and taking into consideration the various factors which will influence future production, it is calculated that the Calgary Region will provide approximately 10-15% of the total sour gas and 30% of the sulphur


Proven Sour Gas Reserves
Completed Producing Sour Gas Well
Potential Producing Sour Gas Well
Existing Sour Gas Processing Plants
Licensed Emmissions as of Jan. 1987 (tonnes per day)
7.2
0
10
20
30
Kilometres
Shell 21.3
Petrocan
Pan Canadian
Shell 22.4
CANMORE
COCHRANE
Stoney Indian Reserve
CALGARY
Petrocan
STRATHMORE
Sarcee Indian Reserve
Blackfoot Indian Reserve
ROSEBUD RIVER
BOW RIVER
ELBOW RIVER
SHEEP RIVER
HIGHWOOD RIVER
Esso
Western Decalta
OKOTOKS
Western Decalta 0.6
HIGH RIVER
Occidental 10.0
26.6

NOTE: ✧6 Indicates number of Gas Wells in a Section

The old Decalta Turner Valley Gas plant ceased operation in mid May, 1985. It has not been de-commissioned yet.

The PCP Morley gas plant ceased operation in Oct. 1985. It has not been fully restored and consequently its ERCB approval has not been rescinded yet.

Figure 2

Sour Gas Facilities

production in Alberta. The Calgary Region represents a significant portion of the total Provincial sour gas resource. Figure 3 illustrates the potential gas reserves within the Region and from the map, the importance of the resource is clearly evident. The sour gas industry is an integral part of our Regional economy, providing jobs and revenue to the municipalities. It is a resource that will continue to expand as new and innovative exploration and drilling techniques are developed. It is because of the importance, extent and static nature of sour gas development within the Region that this report was prepared.

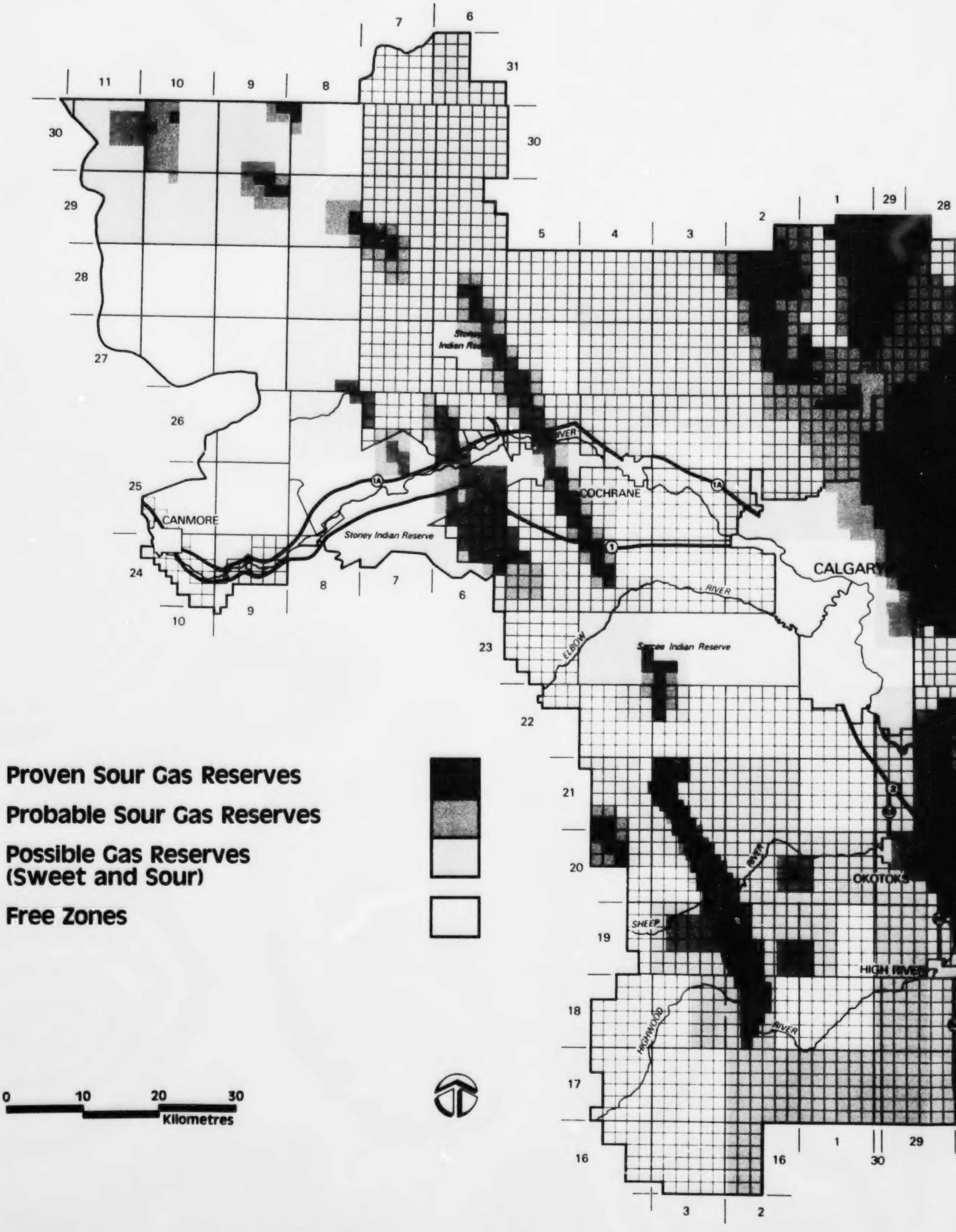
The future of the natural gas market in Alberta is influenced by three major factors:

(a) the continued exploration and development of reserves;

(b) the ability to continue to produce gas from known reserves; and

(c) the regulations applied by the Energy Resources Conservation Board and the Provincial Government to the extraction of the resource in Alberta; and the National Energy Board and the Federal Government in export sales for the product.

The amount of sour natural gas that is currently produced, and will be produced in the future, is similarly affected by these factors.


Proven Sour Gas Reserves
Probable Sour Gas Reserves
Possible Gas Reserves (Sweet and Sour)
Free Zones
0
10
20
30
Kilometres
CANMORE
COCHRANE
CALGARY
OKOTOKS
HIGH RIVER
Stoney Indian Reserve
Stoney Indian Reserve
Sarcee Indian Reserve
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RIVER
ELBOW
SHEEP
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HIGHWOOD
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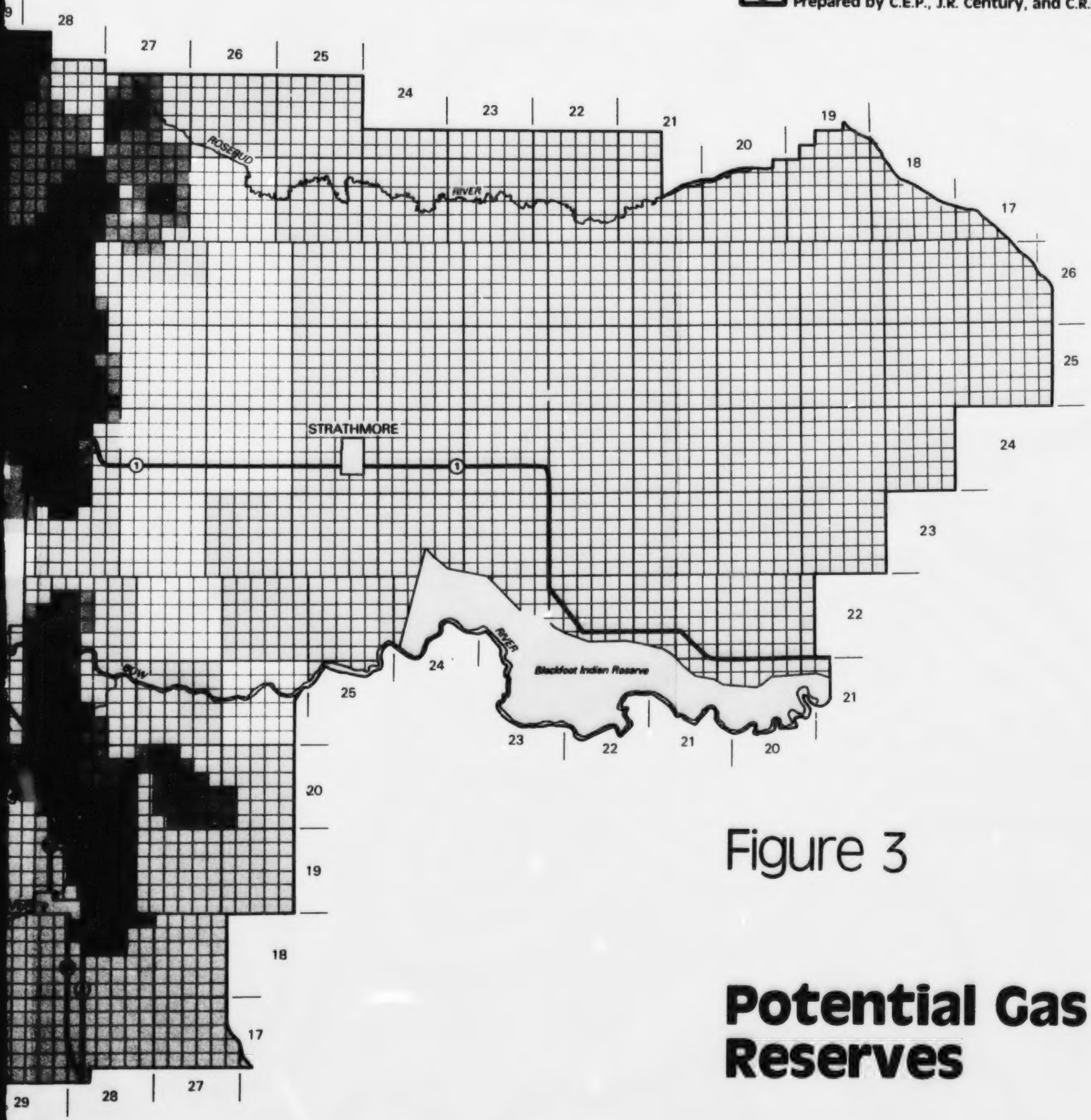
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ROSEBUD
RIVER
STRATHMORE
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BOW
RIVER
Blackfoot Indian Reserve
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Figure 3

Potential Gas Reserves

2.0 THE PURPOSE AND FUNCTION OF VARIOUS SOUR GAS FACILITIES

2.1 WELLS[1]

A well is defined in the Oil and Gas Conservation Act as "an orifice (hole) in the ground completed or being drilled

(i) for the production of oil or gas,

(ii) for injection to an underground formation,

(iii) as an evaluation or test hole, or

(iv) to or at a depth of more than 150 metres, for any purpose".

The purpose of each type of well above is described more fully in the ERCB Guide G-33 (Application For A Well Licence). However, for the intent of this discussion the respective purposes are as follows:

(i) to obtain production of oil, gas, or crude bitumen;

(ii) to inject (natural gas, liquid petroleum gas, fresh water, produced water, industrial waste, etc.) into an underground formation;

(iii) to evaluate an oil sand or obtain geological/geophysical information;

(iv)
- to obtain gas production for domestic use
- to obtain water production for domestic use, commercial use or as a supply for injection purposes
- to obtain hydrological information or observe and monitor water zones.

2.1.1 Applying for a Licence to Drill a Well

Part 6 of the Oil and Gas Conservation Act and Part 2 of the Oil and Gas Conservation Regulations describe the various procedures and information required by the ERCB. As previously mentioned, the ERCB Guide G-33 outlines the necessary information required for a well licence application and it also itemizes applicable ERCB Interim Directives and Informational Letters.

The ERCB Well Licensing staff routinely complete numerous checks of each well licence application to ensure compliance with the various policies and regulations.

A summary of the well licensing process is as follows:

One of the first things an operator must do is to obtain the rights to produce from the formation which he is interested in drilling to. These rights may be owned by the "Crown" (Alberta Forestry, Lands and Wildlife); "Freehold" (private or corporate owned minerals), or by "Other" which includes Indian Minerals and Federal Crown.

The operator must also obtain a surface lease for the well from the surface landowner. If a lease cannot be obtained, an extensive process is implemented that may involve several Government agencies, a public hearing, field meetings for negotiations or mediation and a further technical review of the application. Section 4.0 of the report deals more specifically with the issue of surface lease negotiations.

The potential for encountering sour gas is also reviewed during processing of a well licence application.

Where an application is to be made to the ERCB for a licence for a well to be drilled into a formation known or expected to contain sour gas, the applicant must address ERCB Interim Directive ID 87-2, the requirements of the Oil and Gas Conservation Act, the Oil and Gas Conservation Regulations and ERCB Guide G-33 (Application for a well Licence).

Interim Directive ID 87-2 was produced in the spring of 1987, and replaces and consolidates the sour gas well drilling and licencing requirements of Draft Interim Directive ID 84- (Blowout Prevention of Sour Wells), Interim Directive ID 81-3 (Separation Requirements) and Interim Directive ID-OG 76-2 as they apply to the licencing and drilling of sour wells. ID 87-2 is reproduced in Appendix 2 of this report.

Further directives to be issued by the ERCB will address requirements for completing, servicing and producing critical sour wells as well as the separation distance requirements for locating sour pipelines and associated facilities.*

In general terms, the following broad areas are reviewed when an application is made for a licence to drill a sour well:

° gas flow rate, percent of H_2S and the resultant H_2S release rate

° proximity to urban centres and occupied dwellings

° detailed technical review

° setback requirements

° land use restrictions

° future pipeline routes

---

* The portion of Interim Directive ID 81-3 that deals with locating sour gas pipelines and gas plants currently remains in effect. A replacement Interim Directive dealing specifically with these two facilities is forthcoming from the ERCB.

- detailed drilling plan, as required for critical sour gas wells

- detailed emergency response plan, necessary on an as-required basis

- inspection criteria.

In addition to the previous factors, the following list includes some of the other items routinely addressed during the review of a well licence application.

(a) Environmental considerations:

  - referral of sensitive locations to Alberta Environment (lakes, rivers, etc.)

  - restricted development areas

  - critical wildlife areas

  - mining operations

  - archaeological areas (Informational Letter IL 82-11)

(b) Proximity to airports;

(c) Proximity to surface improvements/roads.

After the review process, the ERCB may issue a well licence and the operator may commence the drilling operation subject to the provisions stipulated on the well licence and the applicable drilling regulations. (Sections 8.129 through 8.143 of the Oil and Gas Conservation Regulations deal with Drilling Blowout Prevention.)

2.1.2 Well Production Facilities

Once a well is drilled, it is either completed or abandoned. The typical reasons for abandonment are as follows:

- ° the well is no longer commercially productive of oil or gas;
- ° testing and logging failed to disclose evidence of commercially recoverable hydrocarbons;
- ° necessary to abandon for safety or mechanical reasons.

After drilling is completed, a well may be put on production immediately or left in a "suspended" state awaiting pipeline or production facility construction usually dictated by the current market availability for the oil or gas.

The type of surface production equipment for an oil or gas well differs significantly. For an oil well, the structure is commonly referred to as an "oil battery" and is for the purpose of separating the well effluent into oil, gas and water for measurement and disposition to market. Typically several oil wells will produce to one battery. Oil batteries require ERCB approval and must meet strict environmental and production regulations.

Gas well installations also require ERCB approval and the amount and type of surface equipment required will vary with the type of well effluent and whether or not hydrogen sulphide is present in the gas. Typically, gas well installations require less equipment than an oil battery.

2.1.3 Well Lease Size

A typical well lease is square in shape and has sides measuring approximately 120 metres. There is, however, no minimum or maximum lease size or shape requirements. The operator's plans for the site will dictate the lease size and shape and they are negotiated with the landowner. The following considerations are taken into account:

- spacing requirements for drilling operations;
- spacing requirements for completion and production operations;
- expected lease use, i.e. oil battery, gas well installation, gas plant, etc.; and
- site development, maintenance and landscaping requirements.

With typical well leases where little or no surface equipment is required, the operator normally allows the landowner to farm the unused portions of the lease.

2.1.4 Well Site Inspections

Inspection of well and production equipment sites are conducted by ERCB field staff. Factsheet No. 3 of the ERCB Enerfax publication series describes the ERCB inspection and enforcement role in Alberta (see Appendix 4).

Specifically, with respect to well sites, the following types of inspections may occur throughout the life of the well.

- predrilling site inspection for environmental concerns;
- drilling rig inpsection;
- completion and service rig inspection;
- initial production testing inspection;
- production facility inspection;

- routine lease inspection conducted at a predetermined frequency; and

- production practices and records audit.

The Oil and Gas Conservation Regulations cover these various inspections and the detail and description surrounding each type will not be discussed here. Inquiries in this area should be made directly to the ERCB.

2.2 PIPELINES[2]

A pipeline is defined under the Pipeline Act as "a pipe used to convey a substance or combination of substances, including installations associated with the pipe but does not include

(i) a pipe used to convey water other than water used for an oil, gas, or oil sands facility,

(ii) a pipe used to convey gas below a maximum pressure of 700 kPa and not used for an oil, gas, or oil sands facility,

(iii) a pipe to convey sewage".

2.2.1 The Procedure for Applying to Construct a Pipeline

(i) The procedure is two-fold: an application for a permit to construct a pipeline is made and a decision rendered and if the application is granted, then application for a licence to operate the pipeline is required. With regard to regulated pipelines, Ministerial approval, pursuant to the Pipeline Act, is required relative to matters of the environment. The operator first applies to the Pipeline Department of the ERCB for a permit to construct a pipeline, in accordance with the Pipeline Regulations under the Pipeline Act. The permit authorizes construction of the pipeline and also its operation for a specified time subject to a satisfactory pressure test having been conducted. The applicant is required to provide information relating to the volume and characteristics of the substance being transported and on the materials and design of the pipelines and installations. The ERCB's Interim Directive ID 81-3 (Appendix 2) outlines the requirement for a permit for a pipeline to transport sour gas. It also gives the minimum distance requirements separating new sour gas facilities from residential and other developments. It should be noted that an Emergency Response Plan is required for sour gas pipeline applications, for pipelines containing gas greater than one percent hydrogen sulphide (or as directed by the ERCB).

Guidelines for Emergency Response Plans will be discussed in detail in Section 8.4 of this guide.

(ii) In reviewing the permit application, the ERCB examines the technical and design aspects of the proposed pipeline, and the impact on landowners and occupants along the route as well as on the environment.

(iii) Generally, the applicant negotiates with the landowners and occupants along the pipeline route to obtain consent, easements, and working space for the pipeline construction. The applicant advises the ERCB at the time of application of the easements that have been obtained and those that are still outstanding. A list is required of the names, addresses and land descriptions of land owners and occupants of land wholly or partially within the setback distances designated in ID 81-3.

(iv) Where the ERCB is unsure as to whether or not there are objections to the pipeline, it will usually publish a notice of the application, advising that it may grant the permit unless it receives an objection by the date specified in the notice. The Notice for Objection is usually sent to all occupants and landowners along the proposed route and is published in appropriate newspapers.

(v) If an objection is received as a result of the published notice, the ERCB will ask the applicant to attempt to satisfy the objection and have it withdrawn. If the objection is not withdrawn, the ERCB will hold a public hearing. At the public hearing, the ERCB considers the application and the objection(s) and can grant the application, as presented, or with conditions, or decide to refuse the application. Where the applicant requests a hearing, or where it is reasonably clear that the ERCB would receive objections if it published a notice of the application, the ERCB may proceed directly to a public hearing. It should be noted that a Notice of Hearing is published in all cases.

(vi) If the application is granted, the applicant is issued a permit to construct the pipeline.

(vii) The construction phase is inspected by ERCB inspectors in accordance with ERCB pipeline inspection objectives. The objectives are established having regard for, among other things, the degree of potential hazard associated with the type of line, its location, and operating conditions. Sour gas lines are among those having the highest inspection priority.

(viii) Upon completion of the construction phase, the pipeline is tested according to requirements of the Pipelines Regulations. Once the line is satisfactorily tested, the applicant applies to the ERCB for a licence to operate the pipeline.

2.2.2 Pipelines and Rights-of-Way

The size of the pipeline varies, depending on the volume of gas it is carrying and the pressure of the gas. The size of a pipeline may also take into consideration the future demands on the pipeline relating to increased production from the same fields.

Though the size of the pipeline does not directly indicate the hazard potential, it is involved in the calculation of the H_2S release volumes and therefore the corresponding facility level rating. These will be discussed in Section 8.0 of this guide.

Right-of-way widths are determined by a number of factors. These include the pipe size, the number of parallel pipes in the ditch, the type of soil, the depth of the ditch, topsoil stripping requirements, the space needed for other related facilities and negotiable width with each specific landowner. Generally, the size of the right-of-way does not vary from one property to the next, but site-specific conditions may necessitate adjustments.

The right-of-way width is frequently specified by the applicant in the permit application but there is no established requirement that it be specified. However, the ERCB may prescribe a different width of right-of-way if the applied-for width is not appropriate for the circumstances.

2.3 SOUR GAS PROCESSING PLANTS

A processing plant, as defined by the Oil and Gas Conservation Act is "a plant for the extraction from natural gas of hydrogen sulphide, helium, ethane, natural gas liquids or other substances, but does not include a wellhead separator, treater or dehydrator".

In general terms, a sour gas processing plant is a facility that receives raw sour gas (gas which contains H_2S), via pipelines from producing wells in the area, and removes or strips the H_2S from the gas; therefore, "sweetening" it and making the gas marketable. Depending on the size of the gas plant and the volume of raw gas that it processes, all of the H_2S which the plant removed from the gas would be burned at the top of a flare stack and sulphur dioxide (SO_2) would be emitted. In larger gas plants the H_2S which was removed from the gas would be directed to the plant's sulphur recovery unit where it would be processed to produce an elemental sulphur product. At this kind of a gas plant, some of the tail gas which remains cannot be processed further and it is then incinerated and the product of the incinerated tail gas, SO_2, would be emitted to the atmosphere through the plant's incinerator stack at controlled rates.

Where the sour gas processing plant utilizes a sulphur recovery unit, the elemental sulphur is recovered in a pure form; the molten sulphur is cooled and restructured into pellets or slates and marketed.

Figure 4 is a diagram of a typical sour gas plant. Specifically, the process, as per the diagram, is as follows:

The raw sour gas which enters the plant via pipeline from field wells is made up of three principal components: formation water, hydrocarbon liquids and gas containing H_2S and other impurities.

The inlet separator separates these three components. The salt-laden formation water is disposed of, usually by injection into underground formations. The hydrocarbon liquid or sour condensate is transferred to the condensate stabilization unit and the gas or vapour component, still containing H_2S is transferred to the gas sweetening phase.

In the condensate stabilization phase, the hydrocarbon liquid is heated in vessels and this heat reaction separates ethane, propane and butane from the condensate (C5+). The ethane, propane and butane are driven off and returned to the gas sweetening phase. The condensate (C5+) is recovered and sent to storage.

In the gas sweetening phase, the sour gas is bubbled through a liquid solvent (amine) that removes the H_2S and other impurities. The sweetened gas is then transferred to the dehydration and hydrocarbon liquid recovery sections of the plant where any remaining water, propane, and butane products are removed. The

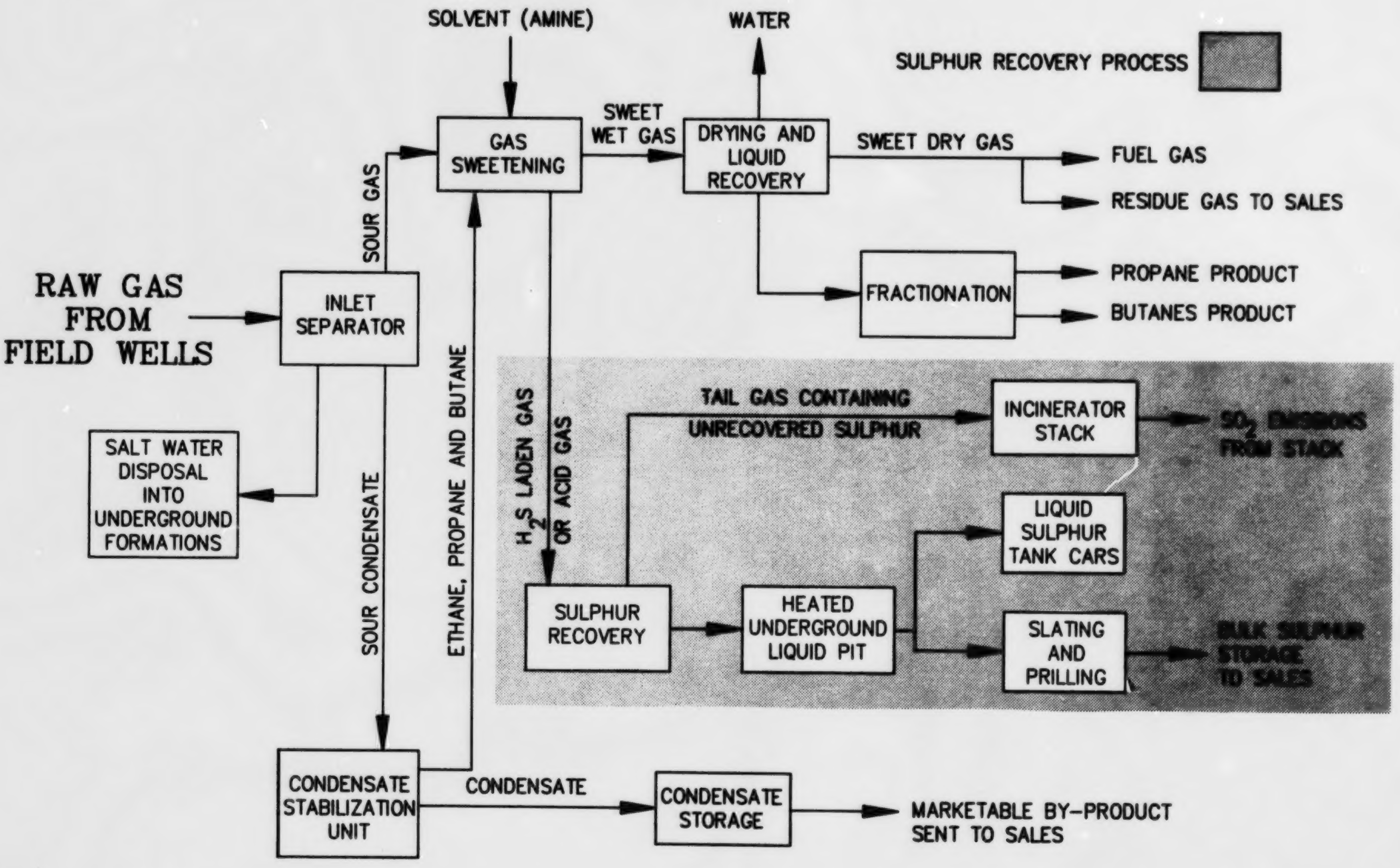

SOLVENT (AMINE)
WATER
SULPHUR RECOVERY PROCESS
GAS SWEETENING
SWEET WET GAS
DRYING AND LIQUID RECOVERY
SWEET DRY GAS
FUEL GAS
RESIDUE GAS TO SALES
SOUR GAS
RAW GAS FROM FIELD WELLS
INLET SEPARATOR
FRACTIONATION
PROPANE PRODUCT
BUTANES PRODUCT
SALT WATER DISPOSAL INTO UNDERGROUND FORMATIONS
SOUR CONDENSATE
ETHANE, PROPANE AND BUTANE
H_2S LADEN GAS OR ACID GAS
TAIL GAS CONTAINING UNRECOVERED SULPHUR
INCINERATOR STACK
SO_2 EMISSIONS FROM STACK
LIQUID SULPHUR TANK CARS
SULPHUR RECOVERY
HEATED UNDERGROUND LIQUID PIT
SLATING AND PRILLING
BULK SULPHUR STORAGE TO SALES
CONDENSATE STABILIZATION UNIT
CONDENSATE
CONDENSATE STORAGE
MARKETABLE BY-PRODUCT SENT TO SALES

Figure 4

Sour Gas Processing

dry sweet gas is then ready to be used as fuel gas or transported to market. The propane and butane condensates that are recovered are compressed to produce a mixed liquid product (LPG mix) or, this recovered product may be fractionated (distilled) to produce separate liquid products (specification propane and specification butane).

At larger gas plants, H_2S rich acid gas from the plant's sweetening section is directed to the facilities' sulphur recovery unit.

2.3.1 The Sulphur Recovery Process

The industrial process of sulphur recovery first began in the Province in the 1950's at Shell's Jumping Pound Plant, located southwest of Cochrane. The reasons for developing the process were three-fold. Firstly, the health hazard that hydrogen sulphide (H_2S) poses in higher concentrations necessitated a process which would break down the dangerous compound into less harmful components. Secondly, the sulphur component of H_2S is extremely corrosive. Use of gas with high H_2S content would necessitate expensive and time consuming anti-corrosion practices. Thirdly, elemental sulphur, one of the products of the sulphur recovery process is marketable, therefore providing additional profits to an operator that incorporates the recovery process.

Elemental sulphur is primarily used in the production of fertilizer. Large quantities of elemental sulphur are exported to such countries as India and Tunisia where soils exhibit sulphur deficiency. Elemental sulphur is also used in the preparation of concrete blocks, pavement materials and in the production of rubber. Currently, Japan is one of the major buyers of elemental sulphur.

The sulphur recovery section is downstream of the plant's gas sweetening unit. The H_2S laden gas leaving the gas sweetening portion of the plant is termed "acid gas" which contains mainly H_2S and carbon dioxide (CO_2). This stream is directed to the sulphur recovery unit which converts the H_2S to elemental sulphur.

The conversion of H_2S to sulphur was first accomplished about 90 years ago in England by a man named Claus. He burned H_2S gas in a large reaction chamber in the presence of a catalyst to generate elemental sulphur. Subsequent improvements in the technology such as separating the combustion step from the catalytic reaction step, with waste heat recovery after the combustion step resulted in what is now referred to as the "Modified Claus Process".

The chemical conversion of H_2S to elemental sulphur is accomplished in two reaction steps. One-third of the H_2S is burned with air to form SO_2 and water vapour:

$$H_2S + 1.5\ O_2 \qquad SO_2 + H_2O\ .\ .\ .\ (1)$$

This reaction occurs in the combustion zone (flame region) of the reaction furnace. As soon as the first reaction takes place a second reaction occurs, namely between H_2S and SO_2 to yield sulphur and water vapour:

$$2H_2S + SO_2 \qquad 3/n\ Sn + 2H_2O\ .\ .\ .\ (2)$$

The second reaction is an equilibrium reaction, which means that it does not go 100% to completion.

The percentage of sulphur, contained in the acid gas, which is removed and recovered as elemental sulphur in the Claus sulphur recovery plant ranges from 95.0 to 98.7 percent (sulphur recovery efficiency level). The unrecovered sulphur which remains in the tail gas is directed to the plant's incinerator stack and is discharged to the atmosphere as SO_2. The sulphur recovery efficiency level attainable in the sulphur recovery unit depends on several factors including the following:

(i) acid gas feed quality (percent H_2S, CO_2, COS, H_2O, and hydrocarbons in the acid gas stream);

(ii) number of reaction stages in the sulphur plant;

(iii) plant mechanical design;

(iv) process design;

(v) catalyst condition; and

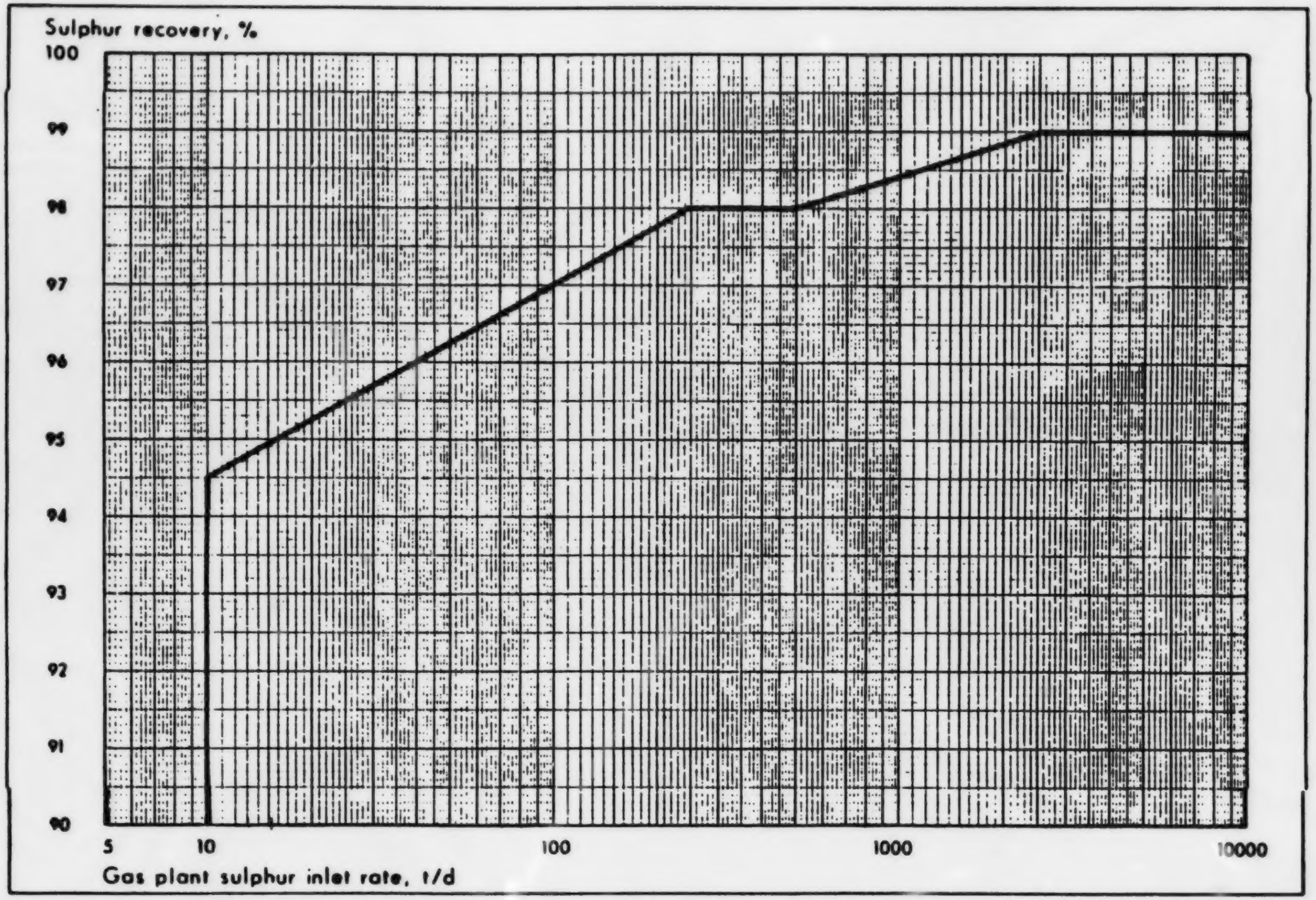
(vi) plant feed rate.

The recovered sulphur product is normally transported into a heated underground liquid pit and after gauging (measuring the volumes produced), is pumped to either a liquid sulphur tank car loading area or is formed into slates or pelletized through prilling for shipment by rail to export markets. The forming of sulphur (slating and prilling) was developed to avoid the sulphur dust problem which has been associated with solid sulphur break out from the cast and blocked sulphur in the past.[3]

The ERCB, in its Informational Letter IL 80-24, outlines sulphur recovery guidelines for gas processing operations for new plants (after 1980), plant expansion, modification or life extension of existing plants (pre-1980). Figure 5 is taken from this Informational Letter and illustrates the sulphur recovery requirement for gas plants with various sulphur inlet rates. The following is a summary of Informational Letter IL 80-24.

". . . some variance may be appropriate in particular circumstances. For example, where there are overriding local environmental considerations, sulphur recovery may be required at small plants having a sulphur inlet rate of less than 10 tonnes per

Attachment to Informational Letter IL 80-24



ALBERTA GAS PLANT - SULPHUR RECOVERY REQUIREMENT [1] day. At plants with severe design constraints or operating conditions, a modest reduction in the required recovery level may be permitted if this appears to be environmentally acceptable. A decision to deviate from the normal requirement would not be made without the input of persons who may be adversely affected."[4]

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[1] At normal operating conditions. Deduct 0.3 % for quarterly average requirement.

Figure 5

2.3.2 New Plants

As per Informational Letter IL 80-24, Figure 5 applies to plants processing good quality acid gas or acid gas containing more than 40 percent hydrogen sulphide. Relaxation of the standards may also be applied for if poor quality acid gas is to be processed. This and other exceptional cases will be considered individually. Approvals issued by the ERCB will stipulate a required quarterly average recovery of 0.3 per cent less than the recovery determined from Figure 1, allowing for start-ups and shut-downs or abnormal operating conditions.

2.3.3 Plant Expansion, Modification, or Life Extension

The Informational Letter IL 80-24 states:

"Plants being expanded or significantly modified will be assigned a sulphur recovery requirement on an individual basis having appropriate regard for the new requirements and such factors as the nature and extent of the expansion, environment protection, economics, and the forecast sulphur inlet rates. Similarly, where substantial new reserves of sour gas are to be processed in, and thus would extend the life of, a plant whose recovery efficiency was established under previous guidelines, the plant's sulphur recovery requirement would also be reviewed having regard for the same factors."

2.3.4 Existing Plants

"Existing plants not included in the above categories remain subject to the sulphur recovery requirements stipulated in the respective approvals.

An operator of an existing plant which is receiving gas from fields undergoing a decline in deliverability may apply for a reduction in the recovery efficiency requirement. The decision on an application of this type would be based on such relevant considerations as environmental impact, sustainable plant throughput, plant turndown ratio, and sulphur recovery efficiency experience at the plant."

The current Provincial average sulphur recovery is 97.5%. This is one of the highest averages achieved in sour gas producing areas world wide and is the result of higher licencing standards as set out by the ERCB and Alberta Environment and the subsequent level of research and technology developed to increase the efficiency of the recovery process.

2.3.5 The Process to Apply for a Permit to Construct, and a Licence to Operate a Sour Gas Plant[4]

(i) The operator applies to the ERCB Gas Department for a permit to construct and operate a gas plant under Section 26 of the Oil and Gas Conservation Act and the Oil and Gas Conservation Regulations. The regulations outline the requirements for all plants from the smallest to the largest megaproject. In essence, the standards and criteria are the same. ERCB Guide G-26 is a Guide to Content for Sour Gas Processing Plant Applications to the ERCB. The following is a summary of the information contained in the Guide.

(ii) Once the ERCB receives the application, it is registered with their legal department and complete copies of the application are sent to the Standards and Approvals Division of Alberta Environment to ensure compliance with codes and standards for air and water quality, emmission rates etc., the Field Staff of the ERCB, to allow an examination of topography and terrain conditions at the proposed site and, to other Departments within the ERCB, to allow for the examination of the technical completeness and review the measurement and accounting aspects of the proposal. The ERCB Gas Department reviews the technical aspects of the application to ensure conservation is maximized and pollution is minimized. The applicant has to specify whether communication with the local residents and general public has been sufficient and whether communication with other operators has taken place.

Also, at this stage, a brief description of the application is forwarded to the appropriate Local Health Unit, the affected rural municipality, any affected urban municipalities, Alberta Energy and Natural Resources and Workman's Compensation Board. The information process allows for input from all of these agencies and is documented at the ERCB level and submitted to the operator.

(iii) Should no deficiencies or potential problems be identified then the application is deemed to be complete and will be approved in principle. However, if deficiencies are identified then a letter is sent to the operator and the operator is given the opportunity to respond. This process is repeated until the application is deemed to be complete by the ERCB.

(iv) If serious problems are encountered with the application, such as resident objections, or if competition from another operator diminishes the viability of the project, then the ERCB advertises the application for a hearing. Few applications require the hearing process.

(v) Once approval in principle is given, Alberta Environment is requested to issue the appropriate permits and licences under the Clean Air and Clean Water Act, the air monitoring Directive, waste water management standards and a comprehensive set of technical guidelines.

It should be noted that two application routes are available to the operator. If the project is small, the operator may apply for a permit to construct the plant and a licence to operate the plant at the same time. For larger projects, such as the Mazeppa Gas Plant, the construction permit was applied for first and upon completing construction and inspection, the licence to operate was then applied for.

3.0 INSPECTION AND MONITORING

3.1 AIR QUALITY

The operator of a plant is required by legislation and regulations to ensure that the prescribed air quality standards are met near the plant, which is the area subject to the greatest impact and to ensure that total emissions meet standards consistent with maintaining good air quality.

3.1.1 Continuous Automatic Sampling and Analysis of the Air for H_2S and SO_2 near the Plant Site[5]

Alberta Environment selects the number and location of monitoring units or trailers around a plant. The location is based on approved emissions, plant equipment, monitoring history, effects of topography, meteorology and proximity of residences.

The equipment records H_2S, SO_2, wind direction and speed. The data is recorded on an hourly basis throughout the reporting period.

All data recorded must be retained by the operator for 24 months and be available for inspection on request.

The operator is required to report to Alberta Environment within 24 hours any instance when the measured concentration is in excess of the standard applied to that particular plant. Within 72 hours, the operator is required to submit, in writing, details as to the time, duration, rate and concentration of the release. Also, the operator must outline circumstances, action taken to minimize any discharge, and proposed action to prevent future occurrences.

The operator is required to submit, on a monthly basis, the results of monitoring including hourly average SO_2, and H_2S concentrations, wind speed and direction. The monthly report must also include the calibration results and an explanation if the instrument operates less than 90 per cent of the time.

The operator is required to submit an annual report which provides a comprehensive review of the air quality, stack emissions and environmental studies conducted by the operator during the previous year.

3.1.2 Monitoring of Sulphation Levels in the General Plant Area[6]

The number and location of sulphation exposure stations are also specified by Alberta Environment. The number varies according to the size of the plant. Their locations are selected on the same general basis as outlined above, but are more widely distributed.

The stations consist of containers mounted on posts which allow air to contact chemically treated surfaces. The reaction on the chemically treated surface illustrates the various sulphation levels in the air as well as cumulative H_2S. These are monitored on a monthly basis.

The results are included in the monthly and annual reports to Alberta Environment as mentioned above.

3.1.3 Monitoring Stack Emissions[7]

The operator of a plant processing more than 50 tonnes of sulphur per day or emitting more than 10 tonnes per day of SO_2 must have continuous emission monitoring equipment in the incinerator stack.

The equipment records the SO_2 concentration, sulphur emission rate, volume flow rate, temperature and oxygen concentration of the stack gas and must be fully operational 90 per cent of the time, according to ERCB policy.

The operator conducts manual checks each year to confirm that the continous monitoring measurements are within 10 per cent of the manual check measurements.

The operator must report within 24 hours any instance when the recorded values are in excess of the plant approval, followed by a detailed written report in 72 hours.

The operator must submit monthly reports on the continuous emission monitoring including daily results for SO_2 concentration, sulphur emission flow rate and temperature.

The monitoring procedures outlined above are ERCB policy and not addressed in the regulations or directives. However, a document entitled "Guidelines for SO_2 Continuous Emission Monitoring Systems" is currently being prepared by Alberta Environment and the ERCB.

3.1.4 Monitoring Checks[8]

The operator is required to maintain a daily record of the raw gas entering the plant, marketable gas sales, gas used in processing, liquids recovered, sulphur recovered, SO_2 emitted from the stacks, and any gas (sweet or sour) flared.

The operator is required to submit a monthly report to the ERCB showing the daily sulphur balance for the plant.

The operator is required to report to the ERCB and Alberta Environment any uncontrolled, unlicenced or accidental release from the plant.

3.2 SOIL QUALITY

Soil pH testing is required to be conducted by the operator between mid-September and freeze-up. The sampling should be conducted at the same time each year at specific locations to ensure continuity in data.

The testing is required at a minimum of six sampling sites; five in the predominant downwind direction, one in the direction of least wind.

3.3 WATER QUALITY[9]

The operator must contain all liquid wastes and surface run-off water, analyse them and if necessary, treat the liquid to ensure compliance with Alberta Environment's "Gas Processing Plants Waste Water Management Standards".

The operator must obtain the approval of Alberta Environment prior to the release of any liquid.

The operator must continuously measure and record the volume and flow rate of the release.

As outlined in previous sections, the operator is required to report to Alberta Environment within 24 hours, any instance of non-compliance with the approval, permit or licence. Also, the operator is required to submit, in writing, details of the occurrence and steps that were taken to prohibit water pollution or any other environmental hazard.

The operator must submit a monthly report containing the results of the analysis, volume and flow rates, and concentrations of water contaminants, of any liquid discharged from the plant. The monthly report must also include the quantity of waste water stored in pits and lagoons at the plant.

The operator is required to submit an annual report which provides a review of the performance of all waste water treatment facilities and control systems at the plant.

Where special circumstances exist or are suspected, Alberta Environment or the ERCB may direct monitoring over and above the normal requirements, to ensure that any possible local environmental impacts are detailed and remedial action implemented.

These may include:

(i) vegetation surveys by ground level inspections, infra-red aerial photography and laboratory analysis of vegetation;

(ii) detailed analysis of soils;

(iii) aquatic life-form analysis of lakes and streams;

(iv) corrosion studies utilizing samples of barbed wire and steel coupons; and

(v) noise surveys to determine background levels and noise from plants.

3.4 SURVEILLANCE

The ERCB and Alberta Environment staff also conduct a monitoring program of sour gas plants. This program includes evaluation of operator reports, field inspection of plant and monitoring equipment, witnessing of stack emission surveys and investigation of complaints and problems in co-operation with Alberta Environment.

The ERCB and Alberta Environment staff review and evaluate reports of excessive emissions to determine their cause, seriousness and means to prevent future problems. Also staff verify that appropriate corrective measures were undertaken. Where serious or continual readings occur, meetings are held with the operator and a program of corrective action is directed or agreed to. The ERCB's field staff then conduct inspections of the plant to ensure that positive measures are taken within the required deadline.

The ERCB and Alberta Environment staff establish, with the operator of a gas plant, the methods to be used to measure and report all production and emission measurements. Following the plant start-up and periodically thereafter, with a frequency depending on the size and complexity of the operation, the staff inspect the plant to ensure that production and emission data are measured accurately and reported correctly.[10]

The ERCB and Alberta Environment review the reports submitted by the operator for compliance with the operating conditions of the plant. The review examines the consistency and completeness of the various reports, comparison of the air and water quality data with the air and water quality standards, the production and emission data with the plant approval and the adequacy of the monitoring program. The ERCB and Alberta Environment conduct detailed record checks where the operator's raw data, charts and calculations are requested and given careful scrutiny for accuracy, equipment calibration, metering differences and the method used in completing the reports. In conjunction with this check, field inspections are made of the measuring and monitoring equipment.

In addition to the established procedures outlined above, all complaints received by the ERCB, or through Alberta Environment, are promptly checked and discussions are held with the operator. If necessary, the ERCB may make independent tests or measurements. In cases where corrective action is required the remedial measures necessary are determined and a schedule of implementation laid out. Follow-up inspections are carried out until the ERCB is satisfied that all requirements have been met to avoid recurrence of the circumstances leading to the complaint. The complaint is documented and the complainant is advised of the outcome.

The ERCB's field staff conducts regular inspections of sour gas plants on an average of twice per year, and more frequently where circumstances warrant. The regular inspections include:[11]

(i) identification and elimination of potential and actual odour sources;

(ii) ensuring that the plant operator is adequately measuring emissions and is staying within the assigned emission limits;

(iii) ensuring that gaseous, liquid and solid wastes are handled so that there is no hazard to the land and water outside the plant-site; and

(v) ensuring compliance with all the approval conditions.

In addition to the routine inspections of gas plants, the ERCB's staff review all stack survey reports and attempt to witness 15-20% of all surveys conducted each year. Should the survey indicate that the continuous stack emission monitor is not accurately measuring the emission from a stack, then corrective action is required and a follow-up survey requested.

Alberta Environment staff conduct spot-checks of the monitoring equipment and are periodically present when liquid discharges to the watershed are conducted. This ensures compliance with the clean air and clean water licences.

In those instances where additional monitoring has been imposed on plant operators under unusual circumstances identified through complaints, vegetation stress or excessive emissions, the ERCB and Alberta Environment staff conduct spot-checks of the monitoring program. Program results must be reported to one or both regulatory agencies and discussions are held with the operators where follow-up corrective action is indicated.

The ERCB and Alberta Environment staff also conduct air or water monitoring programs, utilizing their own equipment and laboratory facilities. These programs are used to:

(i) measure ground level concentrations of H_2S and SO_2;

(ii) check the operator's monitoring results;

(iii) identify a polluter where more than one source exists; or

(iv) confirm or deny the existence of a problem when a complaint is being investigated.

4.0 LEASE AGREEMENTS AND LANDOWNERS RIGHTS

4.1 WELL SITES

In general, the issues regarding surface rights can be divided into two categories:

(i) monetary compensation which falls under the jurisdiction of the Surface Rights Board;

(ii) the well location and/or access road and other matters which are under the jurisdiction of the ERCB.

The location of a well site is first determined by the geology and topography of an area. The well spacing regulations as prescribed by the ERCB are then employed. For gas wells, the spacing requirement is normally one well per section of land. Within the section, a target location is identified within which the well must be drilled. The proposed well site and access road is then surveyed. During this process, the surveyor is required, under the Surface Rights Act, to make a reasonable attempt to notify the landowner prior to entering the property. The surveyor does not, however, need permission to enter the property. Any damage to the property as a result of the survey is the responsibility of the surveyor.

After the survey is complete, a landman is employed by the operator to negotiate a surface lease with the landowner. For clarification, there are two titles for a piece of land, the surface title which belongs to the landowner and allows him to develop upon or work the land, and the mineral title, which allows the owner of the underground resource the right to extract that resource. Mineral rights are typically held by the Crown and are purchased by operators via the appropriate Provincial Government agencies.

The landman first presents the landowner with a proposed agreement. The document would typically illustrate the location of the well and the access road and would outline the compensation which the company would be willing to pay the landowner. The landowner must be given a full 48 hours in which to review the document. However, the landowner has the right to waive the prescribed period should he wish to expedite the negotiations but it is recommended that the mandatory review period be utilized to carefully review the compensation offered and assess the potential impact to the land. The landowner may accept the landman's offer or reject it. If the offer is rejected, negotiation must continue. In order to construct a road, prepare the well site or drill the well, the company must obtain the permission of the landowner. If consent is not achieved, through the negotiation process, then the ERCB is contacted and advised of the concerns. The ERCB may become involved as a mediator for the purpose of encouraging further negotiations and providing additional information. If this process is unsuccessful, then the matter may be decided at a public hearing. If the concerns are resolved, then the operator will apply to the ERCB for a well licence to drill. Once the licence is issued and a surface lease with the landowner is agreed upon, then the operator can commence drilling. If a surface lease is not agreed upon and the negotiations between the operator and landowner have broken down, then the operator may obtain a Right-of-Entry order from the Surface Rights Board.[12]

The ERCB annual report, Energy Alberta 1986, provides an excellent example of the process in an article entitled "On Being an Intervener at an ERCB Public Hearing", p. 42.

4.2 PIPELINES

Two types of pipelines will be discussed in this section:

(i) gathering system pipelines; and

(ii) major pipelines.

Gathering system lines are typically of smaller diameter and gather the gas from well sites to a central point for separation, treatment or compression. Major pipelines service major refining centres or export systems. These are typically larger diameter pipelines than the gathering system lines and extend for much larger distances.

The landowner has essentially the same rights with regard to a pipeline on his property as for a well. However, the well locations are chosen on the basis of geological information and the spacing and target area requirements set out by the ERCB and are relatively inflexible, but the landowner has more input in negotiating the exact route of a pipeline on his property. The landowner has the opportunity of providing the operator of the pipeline with information specific to his own property which may assist in efficient route selection with minimal impact. It should be noted, however, that pipelines cross more than one property and individual suggestions for routing cannot always be accommodated completely.[13]

The negotiation procedure for pipelines is similar to that for wells. If the landowner(s) are unable to agree with the operator on a pipeline route, the ERCB's pipeline staff are contacted and will act as mediators if required. If agreement is not reached, then a hearing will be held. The ERCB weighs the input from both the landowners as well as the operator in making their decision. Should the ERCB rule in favour of the operator, then a permit to construct the pipeline would be issued.

5.0 NUISANCE PROBLEMS ASSOCIATED WITH SOUR GAS FACILITIES

As with any type of development, nuisance factors occur and can have an affect on the overall quality of life or aesthetics of nearby residents. The most commonly identified nuisance factors are odour and noise. In examining sour gas industry records, odour appears to be the most common nuisance factor with noise identified as a negligible nuisance problem.

5.1 ODOUR

In general terms, there should be no odour associated with sour gas facilities. If there is odour, there is a problem. Odour from sour gas can be detected at approximately 0.01-0.3 ppm hydrogen sulphide (H_2S). Therefore, the most minor leak can be detected by the characteristic "rotten egg" smell.[14] The most common causes of minor odour emissions include:

(i) a pinhole leak in a pipeline, caused by corrosion;

(ii) plant emissions;

(iii) gas escaping from wells or batteries.

With regard to small pipeline leaks, they are relatively rare and when they do occur are quickly identified. Operators are required to use a corrosion inhibitor for protection on all pipelines. Cathodic protection of the external surface of the pipeline is required to be applied within one year of the licence to operate being issued. Also, all pipelines are monitored for pressure. The monitoring process is quite sensitive and minor decreases in pressure are noted along the pipeline at various intervals. Field investigations are carried out at the point where a drop in pressure is noted. A minor leak would be detected through the pressure monitoring process and most small leaks are found by odour reports. Odour is usually detected early enough before it becomes a serious nuisance problem.[15] Odour coming from a sour gas plant means that there is something wrong. The monitoring devices at the sour gas plant would detect a leak of H_2S almost immediately and if it were a minor release, it would be attended to. Anything more severe would require Emergency Response Plans to be put into effect. This will be discussed in greater detail in Section 8.4.

Another common cause of minor odour problems is at battery sites or well sites. These are infrequent, usually of short duration and related to mechanical problems at the well or battery. If a mechanical breakdown occurs and the H_2S content is 1% or higher, then flaring or burning of the gas is required. Approval for flaring is required from the ERCB. The approval process is quick and efficient with the operator of the facility simply calling the ERCB and explaining the need for flaring.[16]

5.2 NOISE

Noise is governed by the ERCB Interim Directive ID 80-2 which states that the actual noise level attributable to any particular operation be measured at a distance of 15 meters from any occupied permanent dwelling, in the direction of the source. The maximum permissible noise levels are as follows:

> "Daytime (7:00 a.m. to 11:00 p.m.) - 65 decibels (dBA)
> Nighttime (11:00 p.m. to 7:00 a.m.) - 50 decibels (dBA)

The levels are to be measured on a sound level meter calibrated to zero decibels at a sound pressure level of 2.0 x 10 -5 Pa."

It should be noted that the ERCB noise guidelines are presently under review and may change.

The most common source of noise complaints is from compressor stations at field or plant sites. These are normally equipped with industrial mufflers which reduce noise to within the permissible limits. The noise guidelines also apply to drilling and servicing. Instances have occurred where drilling has been prohibited during certain hours because of the noise factor but this is very expensive to the operator and generally, added noise reduction devices are installed to permit continual drilling.

Flaring at a well, battery or major gas plants is also a source of noise. However, this is usually short term and can be identified by the presence of some black smoke at the beginning of the flaring procedure.[17]

The ERCB is currently involved in assessing traffic problems related to heavy oil production. This type of industry requires the oil to be trucked and specific transportation problems can occur. For the purpose of this guide, it is noted that transportation problems relating to sour gas facilities are negligible. Some minor traffic problems at the larger plants may occur but the subject of access and traffic control is usually examined and potential problems alleviated at the construction permit approval stage.

In general, the number of nuisance complaints within our Region is relatively low in comparison to the level and extent of development existing here.

6.0 LEGISLATION AND POLICY GOVERNING SOUR GAS DEVELOPMENT

There are two major pieces of legislation which govern sour gas development within Alberta. These are:

(i) The Energy Resources Conservation Act - 1980; and

(ii) The Oil and Gas Conservation Act - 1980.

Other legislation affecting the oil and gas industry includes but is not limited to the Land Surface Conservation and Reclamation Act, the Pipeline Act, the Clean Air Act and the Clean Water Act.

6.1 THE ENERGY RESOURCES CONSERVATION ACT - 1980

The Act created the Energy Resources Conservation Board, renaming the pre-existing Conservation Board and modifying the powers and responsibilities of the Board.

In summary, the purpose of the Act, through the ERCB, is as follows:

(i) to appraise energy reserves and the production capacity of energy resources and energy in Alberta;

(ii) to determine the local Alberta and the external energy market demand for Alberta energy resources and energy;

(iii) to conserve the energy resources of the Province and prevent waste;

(iv) to control pollution and to conserve the environment in the exploration, processing, development and transportation of energy resources and energy;

(v) to set and ensure observance of standards for safe and efficient exploration, processing, development and transportation of energy resources and energy;

(vi) to compile and maintain a data bank of energy resources in Alberta; and

(vii) to provide up-to-date information on energy resources and provide for agencies from which the Provincial Government may receive information, advice or recommendations.

The authority of the Board, through the Act, is wide-ranging in matters of setting policy and procedures for the industry, providing that such actions can be shown to be in the public interest.

By means of the Energy Resources Conservation Act, the Board is empowered to make inquiries and investigations, and make recommendations to the Lieutenant-Governor in Council on measures the Board deems essential to the public interest. This may take the form of rules of practice, holding inquiries, listening to any member of the public who is affected by oil and gas development, issuing orders on proceedings, and recommending actions or studies to be undertaken within a specific time.

6.2 THE OIL AND GAS CONSERVATION ACT - 1980

The purpose of the Oil and Gas Conservation Act is similar to the Energy Resources Conservation Act in its intent to conserve and prevent waste of natural non-renewable resources. However, this Act deals specifically with the oil, gas and crude bitumen resources of Alberta.

"The purposes of this Act are:

(i) to effect the conservation of, and to prevent the waste of, the oil, gas and crude bitumen resources of Alberta;

(ii) to secure the observance of safe and efficient practices in the locating, spacing, drilling, equipping, completing, reworking, testing, operating and abandonment of wells and in operations for the production of oil, gas and crude bitumen;

(iii) to provide for the economic, orderly and efficient development, in the public interest, of the oil, gas and crude bitumen resources of Alberta;

(iv) to afford each owner the opportunity of obtaining his share of the production of oil and gas from any pool or of crude bitumen from any oil sands deposit;

(v) to provide for the recording and the timely and useful dissemination of information regarding the oil, gas and crude bitumen resources of Alberta; and

(vi) to control pollution above, at or below the surface in the drilling of wells and in operations for the production of oil, gas and crude bitumen and in other operations over which the Board has jurisdiction."[18]

In order to fulfill the purpose and intent of the Act, the ERCB is empowered to carry out the following actions:

(i) It may make regulations on: the information to be submitted with any application for well drilling, well abandonment, the resumption of activity, start-up of liquid injection, the spacing of wells, signage, the use and removal of equipment, prescribing of production rates, reporting methods, and the establishment of an information registry of all energy resources and facilities.

(ii) The Board may issue licences relating to well drilling, injection and producing operations for oil, gas and crude bitumen and provides for referral to appropriate Provincial government agencies.

(iii) In terms of oil and gas production the ERCB can designate the field and restrict the amount of production, that is, establish a production plan. This may be achieved by fixing the amount so as not to exceed the market demand for the product. Production is allocated among the various pools, and the Board fixes the quantity to be produced from each pool. The ERCB provides for equal opportunity by distributing that quantity equitably among the wells in each pool.

6.3 THE LAND SURFACE CONSERVATION AND RECLAMATION ACT

The Land Surface Conservation and Reclamation Act addresses all surface disturbances in the province and requires that all disturbed lands be returned to a condition equal to or better than prior to disturbance. The Land Conservation and Reclamation Council has officers who have the authority to require certain action be taken to ensure the conservation of the soil.

Larger surface disturbances are referred to as "regulated disturbances" and are subjected to a formal review and approval process by Alberta Environment. Proponents of regulated disturbances must submit a development and reclamation plan to the Land Reclamation Division of Alberta Environment. This development and reclamation plan is reviewed by the Development and Reclamation Review Committee which consists of representatives of a number of provincial government departments. It is also circulated to affected municipalities, local authorities and regional planning commissions. Once a satisfactory development and reclamation plan is developed, it is approved with conditions specific to the surface disturbance proposed. The proponent must also post a bond with Alberta Environment to ensure that the provisions of the Plan are met.

Smaller surface disturbances such as well sites, batteries, and small gas gathering systems are also subject to the regulations of the Land Surface Conservation and Reclamation Act. However, rather than being approved on a project specific basis, they must comply with a set of Reclamation Guidelines developed by the Land Conservation and Reclamation Council.

Prior to any operator abandoning a site where surface disturbance has occurred, they must obtain a Reclamation Certificate from the Land Conservation and Reclamation Council. This certificate indicates that the site has been reclaimed to satisfaction, according to the conditions contained in the approved development and reclamation plan, or the Reclamation Guidelines (whichever is appropriate). For regulated disturbances, the issuance of a Reclamation Certificate allows the operator to redeem its bond held by Alberta Environment.

For major developments, the Minister of Environment may request that an Environmental Impact Assessment be conducted. The Development and Reclamation Plan would then form a part of the more detailed environmental assessment.

6.4 THE PIPELINE ACT

The Pipeline Act applies to all pipelines in Alberta except those governed by the National Energy Board, the Gas Protection Branch, and the Boilers Branch. Under its mandate, the ERCB issues permits to construct and licences to operate pipelines in Alberta (see Section 2.2).

The information required in permit and licence applications is stated in the Pipeline Regulations, Interim Directives, Informational Letters, and manuals.

6.5 REGIONAL POLICY

The Planning Act provides land use planning powers to the Regional Planning Commissions and local municipalities. The Regional Planning Commission establishes overall land use policy for the Region, with which all local statutory plans and development decisions must comply.

With respect to land use planning, there is informal interaction between the ERCB and Calgary Regional Planning Commission (CRPC). The Board advises the CRPC of industry activity and forwards notices of inquiry hearings. In turn, the CRPC circulates subdivision applications to the ERCB for information and comment. As per Section 11.1 of the Subdivision Regulation to the Planning Act, the ERCB, when contacted, is required to provide comments to the CRPC on an application. The ERCB's comments pertain to the location and classification of any sour gas facilities, that is, whether it is a Level 1, Level 2, Level 3, or Level 4 facility, minimum separation distances and any other matter relating to public safety (see Section 8.2). The ERCB does not, however, render opinions or appear at Regional Planning Commission meetings where the elected officials are deliberating on general growth policies or annexation proposals. However, in recent years, the ERCB has called upon the CRPC for assistance in determining the land use impact of sour gas development proposals.

The CRPC is responsible for the guidance and development of land use policy within its area. This takes the form of:

(i) the Regional Plan, a land use policy document;

(ii) subdivision approval authority for certain areas of the Region;

(iii) technical assistance and advice to rural and urban municipalities within the Region; and

(iv) encouraging public participation in the planning process.

As part of the Calgary Regional Plan land use policy, the natural resources of the Region are protected as follows under Chapter 4, Section 14 of the Calgary Regional Plan:

"Municipalities, in their planning documents, should protect areas of known potential resource utilization.

When identifying areas of known potential resource utilization, municipalities should consult with appropriate Provincial departments.

When examining subdivision and development applications, the subdivision approving authority and municipalities should not permit subdivision and development which might prejudice the possible extraction of known potential resource utilization.

For those natural resource extractive industries which are not exempted from the Planning Act or regulated by the Provincial Government, municipalities should ensure that plans for land reclamation accompany development applications for resource extraction.

When examining proposals for resource extraction, municipalities should ensure that land, vegetation and topsoil disturbance and the potential for erosion is minimized. As well, developments should be buffered from adjacent uses."

6.6 LOCAL PLANNING POLICY

With respect to the sour gas industry, all local municipalities have the authority to grant approval for a development permit for a sour gas processing plant. Approvals for pipelines, wells or batteries are, on the other hand, exempt from the regulations and the provisions of the Planning Act.

Some local municipalities can also be granted subdivision approving authority within the Calgary Region. The City of Calgary, the Municipal District of Rocky View and the City of Airdrie presently have subdivision approving authority for their municipalities.

Each of the urban and rural municipalities are affected differently by sour gas development. Present procedures and policies of the four rural municipalities are summarized below.

The General Municipal Plan of the M.D. of Rocky View has mapped known and potential sour gas reserves. The policies in the plan related to sour gas state "where sour reserves and facilites are known, proposed developments are subject to the Subdivision Regulation and review by the ERCB".

The County of Wheatland, a largely agricultural municipality, has recently prepared a new General Municipal Plan. Sour gas has not been a major concern to date, because there are no proven sour gas reserves in the County.

In the Improvement District No. 8 General Municipal Plan, effective March, 1985 it is stated that "The development of sour gas fields should proceed cautiously so that no public safety hazard is created."

The M.D. of Foothills General Municipal Plan, effective July 1986, deals with the planning implications of sour gas development most effectively in the following three policies:

"7.3.7 When reviewing redesignation and development applications which are proposed in the vicinity of sour gas facilities or in areas identified as having sour gas reserves (proven, probable or possible), the M.D. should consult with the Energy Resources Conservation Board, the Calgary Regional Planning Commission and the operator of the sour gas facility. Figure 3 outlines potential gas reserves in the M.D. of Foothills. The Sour Gas Study of the Calgary Region as well as any updated maps attached to it, should be used as an initial reference point in identifying existing facilities and their maximum separation distances.

7.3.8 Minimum separation distances from sour gas facilities as outlined in the Energy Resources Conservation Board Interim Directive 81-3, should be maintained between proposed land uses and sour gas facilities, unless alternative separation distances are recommended by the Energy Resources Conservation Board. If the latter is the case, setbacks as suggested by the ERCB should be maintained.

7.3.9 Persons applying for building permits for lands which would be located in the vicinity of Sour Gas Facilities are encouraged to consult with the operator of the sour gas facility, to ensure that adequate setbacks are maintained."

The M.D. of Foothills has also mapped the proven, probable and possible sour gas reserves within its boundary.

Within the M.D. of Foothills, the towns of Okotoks and High River have a referral mechanism with respect to development permit applications with sour gas facility operators. This was initiated by industry, the ERCB, the CRPC and the municipalities during 1981-1982 because of the proposal by Canadian Occidental for a processing plant in the Mazeppa sour gas field. The towns of Okotoks and High River are in close proximity to a major sour gas field which contains a relatively high concentration of sour gas facilities.

In the absence of site specific information or local planning policy, many municipalities rely on the expertise and advice of the Calgary Regional Planning Commission in planning for sour gas areas.

6.7 THE DEVELOPMENT APPROVAL PROCESS

When a subdivision or development is proposed, the owner or developer applies to the appropriate agency for the necessary permits and when approved, can proceed to develop the land.

In the Calgary Region, where a subdivision is proposed, the applications are reviewed and decided by the particular subdivision approving authority. These are:

(i) the City of Calgary, for all land within the City limits;

(ii) the M.D. of Rocky View for land within its district limits;

(iii) the City of Airdrie, for all land within the City limits; and

(iv) the CRPC for the balance of the land inside the Calgary Regional Planning Commission's jurisdictional area.

Where no subdivision is involved, the owner/developer may approach the local municipality (development officer) for the necessary development and building permits and/or change of land use classification approval in accordance with procedures established in the local land use bylaw. Every development requires a permit before commencement, unless specifically exempted by the land use bylaw. This system of land use control takes into consideration the present land use, existing zoning and the suitability of the property to accommodate the proposed development. Where the location of sour gas reserves or facilities is known to be in conflict with the owner's proposed development, then the regulations of Schedule 6 of the Subdivision Regulations of the Planning Act can be put into effect. (See Appendix 3.)

However, information pertaining to potential sour gas reserve areas and proposed sour gas facilities is not always readily available to the particular approving authority. Approvals for land use change or development permits may be granted in the absence of this information. Unknowingly then, the plans of surface owners may conflict with the sour gas industry. Affected operators can however, find out about pending development approvals through posted notices in the paper.

Presently, in the Calgary Region, only the operators in the Mazeppa and Okotoks fields and those located within the M.D. of Rocky View are advised of development matters earlier in the approval process. Development applications, upon receipt, are circulated by the municipalities to the respective operators in these areas.

7.0 HUMAN HEALTH EFFECTS OF HYDROGEN SULPHIDE AND SULPHUR DIOXIDE

The effects of SO_2 and H_2S on humans varies considerably depending on the respiratory and cardio pulmonary health of the individual. Some people may be more sensitive to the effects of SO_2 and H_2S than will others. The acceptable level used by industry for workers safety is 10 ppm over an 8 hour period. 0.005 ppm is the allowable standard over a 24 hour period.

7.1 HYDROGEN SULPHIDE

H_2S is found in decaying organic matter, natural oil and gas, silos and sewers. It is a gas at temperatures above -60°C. It is colourless and flammable and burns to form SO_2. H_2S tends to disperse more slowly or be more concentrated in sheltered, calm or low lying areas.[19]

As explained in Section 2.3, H_2S is not continually released into the atmosphere in any concentration. It is required that H_2S be converted to SO_2 before it is released to the atmosphere. However, an uncontrolled release of H_2S is possible as a result of a well blowout or a pipeline break or rupture.

In general, H_2S exposure reduces a persons ability to take up oxygen. The symptoms resulting from exposure to H_2S can include to varying degrees: nausea, diarrhea, vertigo or loss of balance, blurring vision, coughing, headache and eye irritation or conjunctivitis. In addition to these symptoms, a characteristic sulphur odour on the breath is common.

The following are general recognized symptoms resulting from various levels of exposure to H_2S. The information has been adapted from three sources:

° Canada Safety Council Data Sheet "Hydrogen Sulphide", No. B-3

- Alberta Provincial Board of Health "Guidelines for Action Regarding Hydrogen Sulphide"
- National Research Council of Canada, "Hydrogen Sulfide in the Atmospheric Environment: Scientific Criteria for Addressing its Effects on Environmental Quality", publication #18467.

It should be stressed that health effects vary with the individual and the following table is only a generalized representation.

CONCENTRATION (ppm)	EFFECTS
.01	One hour Clean Air Act air quality standard
.01-.3	Odour threshold
1-5	Moderate to strong offensive odour may create nausea, tearing of the eyes, headaches or loss of sleep upon prolonged exposure - effects are moderate and reversible
10	Eight hour Occupational Exposure Limit
15	15 minute Occupational Exposure Limit
20	Ceiling Occupational Exposure Limit Evacuation Level
20-50	Slight eye and lung irritation; may cause damage after several days of exposure; may cause nausea, diarrhea and loss of appetite
100	Pronounced eye and lung irritation

150	Paralysis of sense of smell; vertigo; severe eye and lung irritation including cough and chest pains
500	Serious damage to eyes within 30 minutes; severe lung irritation; irrationality; disorientation; anoxia, or lack of oxygen to tissues resulting in unconsciousness and death within 4 to 8 hours
1000	Fatal; pulmonary oedema or swelling of the tissues of the lungs; respiratory paralysis and collapse within one or two breaths.

7.2 SULPHUR DIOXIDE

SO_2 is formed by the combustion of H_2S sulphur and is non-flammable. It is formed as a gas at temperatures above -75°C and exists as a liquid below -75°C.[20]

The acceptable level for healthy workers is 5 ppm per 8 hours five days a week. However, 0.03 - 1.0 ppm may cause minor irritation or brochial spasms in sensitive people. Odour is noticeable at a concentration of 3 ppm. SO_2 is easily dissolved to form sulphuric acid and affects the moist areas of the body including the throat, upper respiratory tract and lungs as well as the eyes and moist areas of exposed skin.

The following table outlines the general recognized symptoms resulting from exposure to SO_2. The information has been adapted from Canada Safety Council Data Sheet "Sulphur Dioxide", No. B-4.

CONCENTRATION (ppm)	EFFECTS
.17	One hour Clean Air Act air quality standard
.3	24 hour Evacuation Level
1.0	Three hour Average Evacuation Level
2	Eight hour Occupational Exposure Limit
3-5	Odour Threshold
5	15 minute Occupational Exposure Limit
8-12	Throat irritation, coughing, constriction in the chest, tearing and smarting of the eyes
10-50	Increased irritation of the eyes, nose, throat, choking, coughing, and in some cases wheezing as a sign of narrowing of the airways (which increases the resistance of the air-flow)
150	Short term endurance due to severe eye irritation and because of the effects on the membranes of the nose, throat and lungs
500	Potential respiratory paralysis
1000-2000	Fatal with continued exposure; respiratory paralysis.

7.3 TYPES OF EMISSIONS

The emission of H_2S or SO_2 into the atmosphere can come from a variety of different sources in the sour gas industry. The following three sources are the most common types of emission:

(i) Continuous release of SO_2 - from the incinerator stack at sour gas processing plants; considered to be controlled and monitored.

(ii) "Blowout" - uncontrolled release of H_2S gas; from wells; during drilling or servicing; because of equipment failure on site; release can be flared.

(iii) Break or Rupture - uncontrolled release of H_2S gas; in gathering or transmission pipelines; usually the result of corrosion or line cutting (third party damages); subject to automatic or manual shut off systems.

With regard to blowouts, the frequency of occurrence is very low. However, the amount of H_2S that can escape is quite extensive and the duration of the escape can be lengthy, depending on the nature of the release and subsequently, the time required to cap the well. The Lodgepole Blowout, which occurred on October 17, 1982 is the most recent example of an extremely hazardous uncontrolled blowout. The ERCB initiated inquiry into this incident and produced the Lodgepole Blowout Report. The report deals with all aspects of the blowout and should be referred to for more detail regarding blowout causes and prevention.

Pipeline breaks or ruptures are generally regarded as less hazardous than blowouts. Automatic or controlled shut off mechanisms are installed along pipelines to reduce the amount of emission should a break occur.

8.0 HYDROGEN SULPHIDE EXPOSURE AND COUNTERACTING MEASURES

8.1 ACTION LEVELS

(i) At H_2S levels below 5 parts per million, people may experience effects such as headache, nausea, eye irritation and wakefulness. These are not serious and are reversible. Above 5 parts per million a health hazard may exist. The following action levels have therefore been established as a guide:[21]

- When average H_2S levels exceed 5 parts per million for 6 hours or 10 parts per million for 1 hour or more and symptoms persist or become more severe, individuals should consider moving from the area.

- When average H_2S levels exceed 10 parts per million for 8 hours or more, local conditions in the area will be assessed and individuals may be advised to leave the area.

- When environmental monitoring indicates that a level of 20 parts per million or more will be reached and conditions indicate that a health hazard exists, urgent evacuation will be advised.

(ii) Similar information regarding other contaminants will be added. These stated levels are to be used as a guide only. Government health authorities will either confirm or amend these levels at the time of the sour gas release and in the light of information available at the time.

8.2 SEPARATION DISTANCES

The ERCB has devised appropriate separation distances from each sour gas facility. These guidelines are essentially the same as those contained within the Planning Act for development setbacks from sour gas facilities. Facility locations on the maps were verified by individual gathering system operators. The maps in Appendix 1 illustrates facility level ratings for pipelines within the Calgary Region. The setbacks shown are the maximum separation distances required under Schedule 6 of the Subdivision Regulation. It should be noted that in referring to the maps in Appendix 1, the nature of the proposed land use must be carefully determined as less stringent separation distances may be required. For example, if the proposed use is a country residential use as opposed to a public facility, then the required separation distance from a level 3 facility is reduced from 1.5 km to 0.5 km. Interim Directive ID 81-3 remains in effect for separation distances relating to pipelines and sour gas plants. As noted previously, separation distances for sour gas wells are now addressed in Interim Directive ID 87-2.

Reference to the Planning Act, and ERCB Interim Directives 81-3 and 87-2 should be made when reviewing a specific situation. The ERCB Interim Directives are shown in Appendix 2.

The Subdivision Regulation only requires the ERCB to submit comments on subdivision applications when contacted by the subdivision approving authority. The ERCB advises on the location and classification of a sour gas facility, that is the facility level rating, and may make recommendations concerning safety measures and setback distances in addition to regulations specified in Schedule 6 of the Subdivision Regulation.

Unlike subdivision approvals, the Planning Act does not require development permit approvals to respect separation distances as outlined in Schedule 6 of the Subdivision Regulation. This is a critical point in that increased co-operation and communication between the development officer and the operator could alleviate potential problems not addressed by mandatory requirements.

The Subdivision Regulation, Schedule 6, pursuant to the Planning Act, is contained in Appendix 3.

In addition to establishing the separation distances, the ERCB, in Interim Directive ID 81-4 (see Appendix 2), requires that an applicant for a well licence or pipeline permit for both sour and sweet gas, include in the application information to ensure that municipal administrators are made aware of wells or pipelines proposed near cities, towns or villages.

8.3 EMERGENCY PLANNING ZONES

An Emergency Planning Zone is an extra measure of protection beyond the separation distances outlined in the previous section. The zone is fundamental to the Emergency Response Plan which will be discussed in the following section and is defined as the distance from the source of an emission to the maximum 100 ppm H_2S isopleth. The old method of using isopleths for setback distances has been discontinued in favour of the new separation distance requirements relating to facility level ratings. However, the 100 ppm isopleth is used in assessing the second level or outer limit from the sour gas plant, well or pipeline. The size of the Emergency Planning Zone is directly related to the potential volume of H_2S release from the specific facility. Figures 6 and 7 illustrate the proportional distances as per the ERCB requirements.[22]

Other criteria are also taken into consideration when outlining an Emergency Planning Zone. For example, if the zone intersects part of a residential subdivision, then the entire subdivision must be included. Also, if a large but irregularly occupied area, such as a campground or recreational facility, is identified, then this is taken into consideration as well and included in the Emergency Planning Zone.

The Emergency Planning Zone is the area considered to be most susceptible in the event of a sour gas release and is the area initially subject to an Emergency Response Plan.

8.4 EMERGENCY RESPONSE PLANS

In addition to the setback requirements outlined in the previous section, the operators of sour gas plants, pipelines and wells are required under the Oil and Gas Conservation Act and the Pipeline Act to prepare Emergency Response Plans in the event of a sour gas release. The objective of these plans is to protect the health and safety of the people surrounding a sour gas facility and to provide an efficient and co-ordinated effort between the affected municipalities, industry operators and the ERCB during emergency procedures.

The Emergency Response Plans are unique for every situation and are related to the potential of a sour gas well, plant or related field facility for creating a hazard to the public. The main initial factors examined when looking at the hazard potential of a facility are the H_2S content of the gas that may be released, the volume of gas and its potential release rate, the proximity of the facility to populated areas and the characteristics of the populated area. The ERCB Decision Report D-84-9 defines critical versus non-critical wells and, based on the hazard potential, the Emergency Response Plan can be adjusted for each situation. A critical well is also defined in Interim Directive ID 87-2 (see Appendix 2). For critical wells, the plan is submitted with the well licence application and must be approved before the well licence is issued. For non-critical wells, the plans must be submitted five days prior to the spudding of a well. That is, the point when the drill bit touches the ground and 30 days prior to the start-up of a sour gas plant. Approval of these plans must be acquired before start-up or spudding. After approval, the Plan is circulated to all government agencies identified as participating in the Plan. The Plan is discussed by the company with the agencies to clearly detail each responsibility and duty.

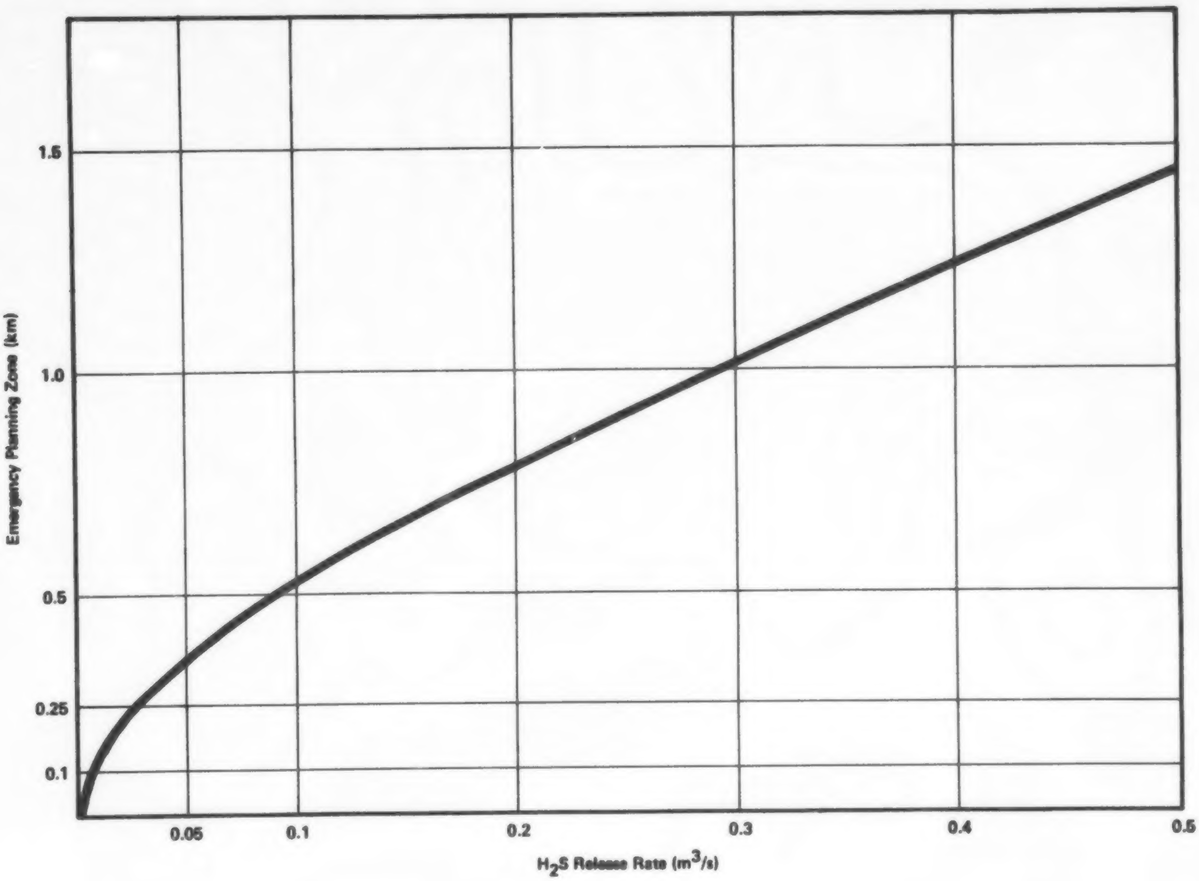

Figure 6

Emergency Planning Zones for Sour Gas Wells

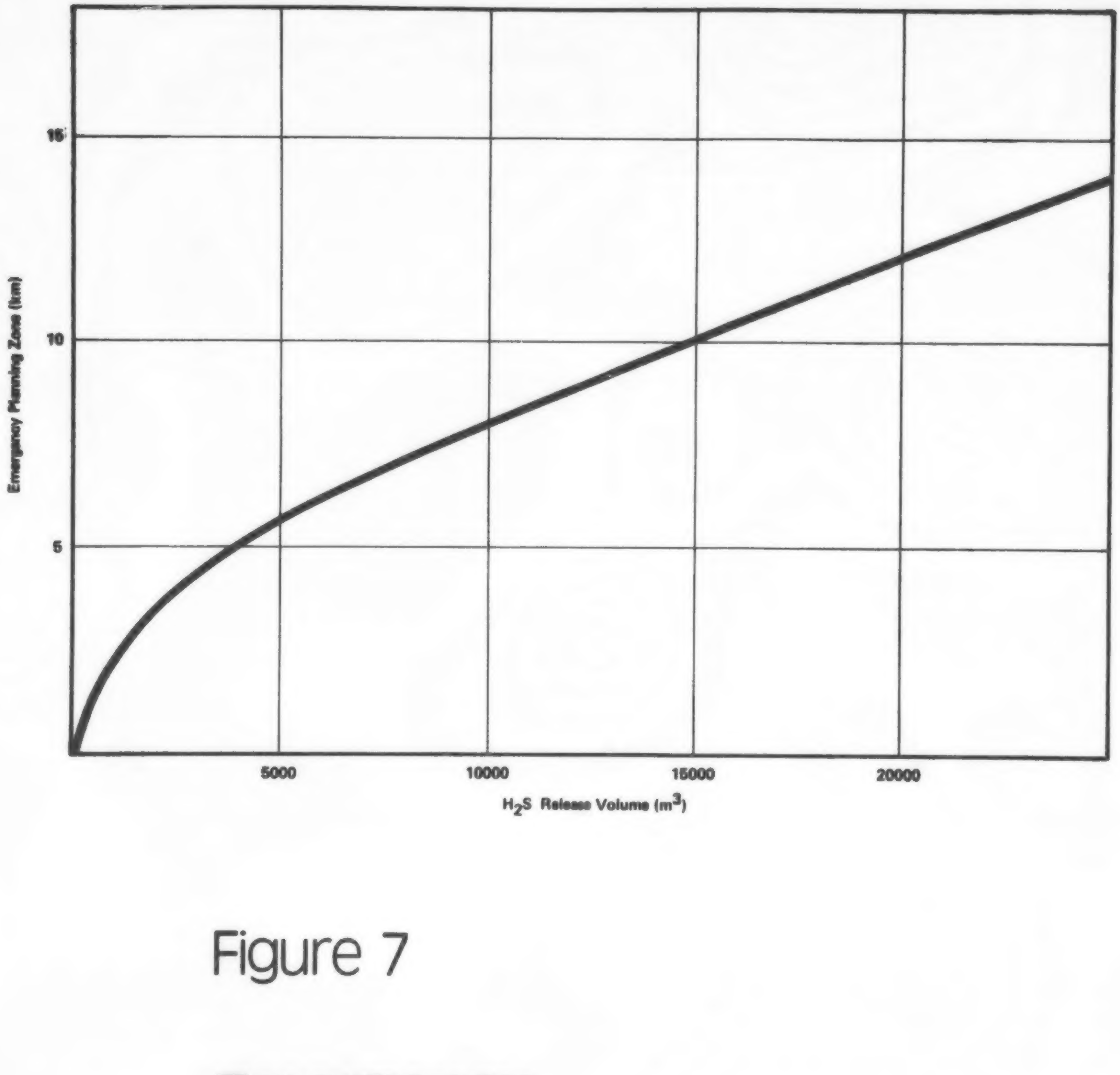

Figure 7

Emergency Planning Zones for Sour Gas Plants and Pipelines

Company personnel must be familiar with the Plan and be instructed on the emergency procedures. Training and experience of plant personnel is vital in ensuring that the Plan will be carried out efficiently.[23]

The Plan contains procedures for assessing the emergency situation, an outline of the responsibilities of the operator and government personnel, methods outlining communication modes to be used and procedures for evacuation of the public within the Emergency Planning Zone.

In addition to providing the details of a response to an emergency situation, the Plans also educate company personnel and are a vital information source during the emergency.

It is encouraged that a high degree of public involvement, through public meetings or open houses, go into the preparation of these plans. In addition to receiving general views from the residents, specific details of the number of residents per household, the number and location of people requiring special assistance, etc., must also be obtained from the public. Also, once completed, the Plans must be made available to the public.

The following list is a very general outline of the information required in the Emergency Response Plan.[24]

- Identify the facilities to be covered in the Plan, that is, plant, well, or pipeline and give the H_2S content of the gas in the particular facility.

- Define what set of circumstances would have to occur before emergency procedures are initiated. Set the criteria for identifying the seriousness of the release.

- Identify the personnel responsible for evaluating the situation and determining the measures to be undertaken.

- It is recommended that other potential circumstances that may require partial implementation of the Plan be outlined.

- Identify the means by which a release would be detected and located. This would include a detailed outline of the monitoring equipment and field checks. Information reported from residents, workers and transients not associated with the company is also a way of detecting a release. These reports must be checked out and documented.

- Provide detailed description of the responsibilities of company personnel and their names are to be provided in an emergency phone list. An alternate must be provided for each person.

- In executing the Emergency Response Plan, emphasis should first be placed on the area immediately downwind of the release point. As a release continues, the hazard area that is subject to the Plan is expanded according to the severity of the release.

- Identify the procedures employed for monitoring the amount and dispersion of H_2S and SO_2 in the air must be outlined in the Plan. This includes procedures for locating and following the plume. From this information, the hazard area is continually redefined by mobile vehicles monitoring H_2S and SO_2.

- The company must illustrate in the Plan how personnel will block major access roads and isolate the hazard area as well as the procedures for obtaining assistance from the RCMP in maintaining the roadblocks. H_2S and SO_2 in the air must be monitored to indicate repositioning of roadblocks.

- Control centres must be identified in the Plan. These centres provide a common area for response co-ordination and communications. The control centre is located well outside the hazard area. The function of the centre is to provide a location where emergency communications can be performed. That is, notification of government agencies and local authorities, communication with hazard area and the company head office as well as the monitoring crews. The centre may also be used to call residents if evacuation is to be done by telephone.

- The roles of the government agencies and the local authorities must be provided in detail and must be agreed upon by all participating agencies prior to Plan approval. The participating agencies include:

  ° ERCB
  ° RCMP
  ° Alberta Disaster Services
  ° Alberta Environment
  ° Alberta Energy and Natural Resources - Fish and Wildlife and Forestry
  ° Alberta Occupational Health and Safety
  ° Board of Health
  ° Local municipal government
  ° Local fire department.

- The personnel authorized to ignite an uncontrolled release of sour gas must be identified. A list of criteria for determining the feasibility of igniting a release must be prepared. Also, the method used for ignition and the subsequent safety procedures are required.

- A personal visit to each resident within the emergency planning zone prior to submission of the original plan and before each annual update is undertaken. At this time, the resident has the opportunity to discuss the Plan, provide input and ask any questions of the operator. Residents must be provided with a residents' information package outlining the exact location of the facility, the possibility of an emergency situation arising, the health effects of H_2S and SO_2 and any action they may be required to take. Personal information from the residents is not made public with Plan. The resident is also provided with telephone numbers for plant personnel.

- The local authority, as defined by the Disaster Services Act, is required by this Act to prepare an emergency plan and program. This plan should contain suitable procedures to assist the company Plan. For an urban area which may be evacuated under such a plan the aforementioned visit by the operator and subsequent resident input will be handled through the Director of the local Disaster Services Agency. The Director is responsible for notifying residents and providing them with the appropriate preparation. Both the Town of Okotoks and the Town of Crossfield have local emergency plans in place at present.

- In the Plan, the operator is required to detail the evacuation plan and include the local emergency plan particulars as well.

- A method must be provided to ensure the safety of all transient persons in the area.

- An evacuation centre must be identified to which evacuated persons may be sent. Procedures must be provided to ensure all persons are evacuated and that their comfort and safety is provided for.

- The public should be kept informed, through media releases, throughout the emergency.

- All persons required to provide medical assistance during the emergency must be informed in advance.

- The basis for the decision to return residents and personnel to the evacuated area must be outlined in the plan and persons responsible for that decision identified.

- A list of emergency equipment and the location must be provided. This includes:
  - ° communications equipment
  - ° detection equipment
  - ° emergency air supplies
  - ° first aid equipment
  - ° flare guns
  - ° emergency plant shut-down equipment.

- The Plan must be reviewed annually by the operator and changes forwarded to the ERCB.

- A meeting to review the Plan and procedures must be conducted with the operator, government agencies and local authorities at least once every two years after the start-up of a facility subject to a Plan.

- Training programs must be employed to ensure all company personnel are fully familiar with the Plan and know their respective duties and responsibilities. Also, periodic in-house emergency simulations should be conducted.

- Regular inspection and maintenance of emergency equipment must be carried out.

- The Plan must be reviewed and updated annually and distributed to the participating agencies.

The following required information forms the section of the Plan that would be utilized by company personnel during an actual emergency situation. The format must be such that this information is readily available when required.

- The emergency telephone numbers must be located in the Plan and be easily and quickly accessible.

- The residents map should be referenced to the residents phone list for use during an evacuation.

- Telephone list of key company personnel. Alternates must be provided.

- Telephone and address of government agencies, including a list of those to be contacted by the ERCB.

- Rural resident list, including the following:

  ° family name
  ° number of residents
  ° telephone number
  ° identification of residences where special assistance may be required during an evacuation.

- Maps (one or more)

  The maps must cover a radius which is a minimum of two times the emergency planning zone radius. The maps must show:

  ° emergency planning zones
  ° residents within zones
  ° evacuation routes
  ° city, town or village limits
  ° public facilities - rural schools and hospitals, campgrounds, and recreational areas
  ° major highways and municipal roads, railways
  ° locations of other oil and gas operations, and any other industries located in the area
  ° locations of sour gas facilities
  ° proposed road block locations
  ° any other information which may be necessary in an emergency situation.

- Phone numbers of Available Emergency Assistance; as appropriate:

  - ° medical: hospitals
    doctors
    ambulances
  - ° aircraft - identify those with available loudhailers
  - ° fire fighting equipment
  - ° extra safety equipment
  - ° electronic monitoring equipment
  - ° heavy service equipment
  - ° list of railway and highway authorities
  - ° other operators and industries in the area.

It is important to keep in mind that each person has a responsibility during an emergency response. Firstly, when the facility operator or Director of Disaster Services visits, it is important to give all the necessary information. This includes any personal respiratory problems, the need for special evacuation assistance as in the case of elderly or handicapped persons, the number of small children in home, working hours and times the home is unattended. Also, it is important to become totally familiar with the Emergency Response Plan so reactions are quick and efficient when the need arises. As previously mentioned, the Plan must be made available to the public. A condensed version of the Plan, or "Resident Package" may be provided. This normally includes the following information:

- emergency telephone numbers
- location and appropriate timing (life) of operation
- potential emergencies
- H_2S and SO_2 information on health effects
- directions if H_2S or SO_2 is suspected in an area
- evacuation procedure
- location of evacuation centre.

It is also worthwhile to become familiar with the symptoms of H_2S exposure. If a resident has medical or first aid experience, it is important to let the operator or Disaster Services know; you may be able to give valuable assistance when called upon. Ask questions, be informed, and give input. The plan, administered by the company personnel, government agencies, local authorities, hospitals and police, is the most efficient and effective way of ensuring public safety.

Annex B to
Government of Alberta
Emergency Response Plan
for a Sour Gas Release
Dated

SOUR GAS RELEASE EMERGENCY INFORMATION FLOW

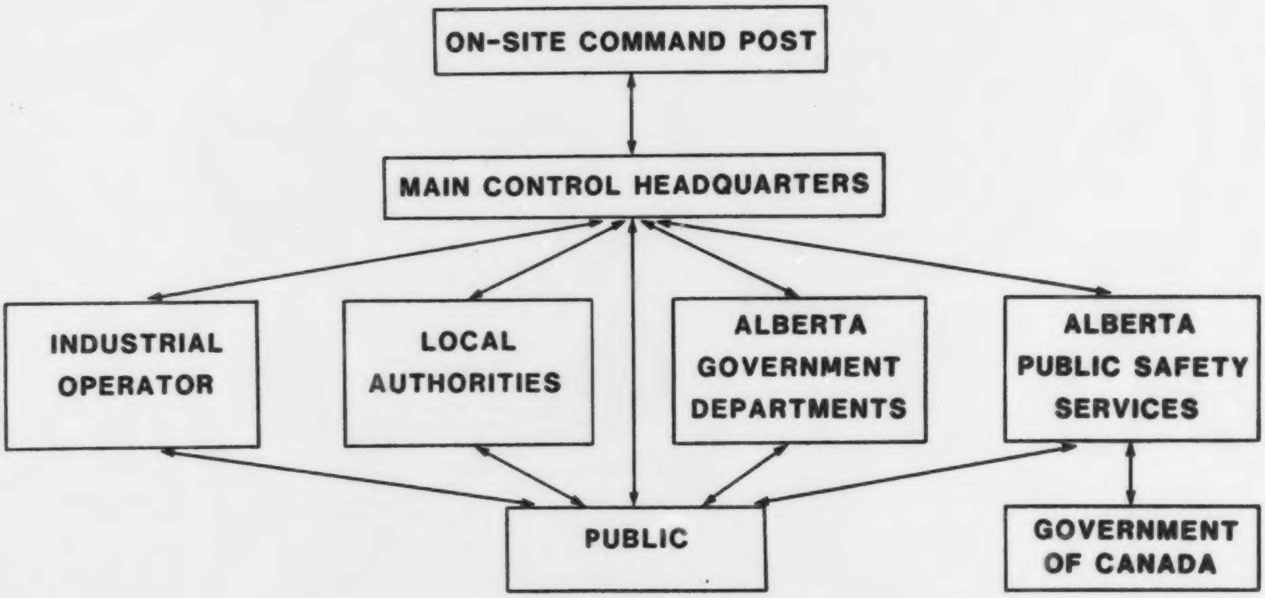
ON-SITE COMMAND POST
MAIN CONTROL HEADQUARTERS
INDUSTRIAL OPERATOR
LOCAL AUTHORITIES
ALBERTA GOVERNMENT DEPARTMENTS
ALBERTA PUBLIC SAFETY SERVICES
PUBLIC
GOVERNMENT OF CANADA

Figure 8

9.0 LAND USE PLANNING AND SOUR GAS DEVELOPMENT

9.1 WHAT IS THE PRIORITY - RESOURCES EXTRACTION OR LAND USE DEVELOPMENT?

The Provincial government has recognized that the rapid and efficient depletion of energy resources is critical. It is in the public interest to recover as much of the resources as possible, as quickly as possible. The energy extraction industry has grown immensely in the last decade in Alberta with innovative exploration techniques and extraction practices being revised and updated regularly. Particularly with regard to sour gas, the direction has been to extract the gas as quickly as possible in order to permit future land uses of the base areas to be planned wisely. Despite the encouragement to quickly deplete resources, urban and rural land uses have grown and changed and specific land use conflict areas have emerged. The answer to the question of priority is probably that both land use development and resource extraction vie for space and that both are equally important since they are interrelated. That is, the growth of the energy extraction industry leads to more jobs, a more diverse economic base for municipalities and the inevitable growth of urban centres in proximity to the activity zones of the extraction industry.

Vast areas of our Region are underlain with both sweet and sour gas reserves that are in demand and marketable. Urban municipalities such as the Towns of Okotoks, High River, Turner Valley, Black Diamond and Crossfield, the Cities of Airdrie and Calgary, as well as the Village of Longview and the Summer Village of Ghost Lake exist in the midst of the energy extractive areas and in some cases have gas wells and pipelines within their incorporated boundaries. Also, in the area south of the City of Calgary, numerous pockets of higher density country residential development exist in proximity to sour gas wells, pipelines and plants. Figure 9 illustrates the urban fringes of incorporated communities in the Region and identifies the potential land use conflict zones. Other areas of conflict exist with regard to country residential development, recreational development, environmentally significant areas, agricultural pursuits and other industrial development. However, due to the hazardous nature of sour gas, the main conflict zones identified relate to areas of high density urban development.

Given the level of sour gas development within the Region and the number of potential conflict zones already existing, the question is no longer that of which use is a priority but whether co-existence of resource development and urban or rural development can be achieved over time.

9.2 LIVING WITH SOUR GAS - A REASONABLE CO-EXISTENCE

Major land use conflict issues have been identified in three recent ERCB hearings. Saddle Ridge (Calgary) and Okotoks (Mazeppa) as well as the West Edmonton situation were identified. Common to each situation was the issue of whether resource development could co-exist with urban or rural development. The major public concerns resulting from the hearings/inquiry were:

- What are the dangers of H_2S?
- What are the risks of accidents occurring?
- What measures need to be undertaken to assure safe existence?
- What are the long-term health effects of prolonged exposure to emissions?
- What nuisance problems can be expected? Noise? Odour?
- If surface development were to preclude resource development, what would be the cost to government and industry?
- What special measures would have to be employed to allow simultaneous resource and surface development?
- What type of problems would be incurred due to land fragmentation, leap frog servicing, land sterilization and devaluation?

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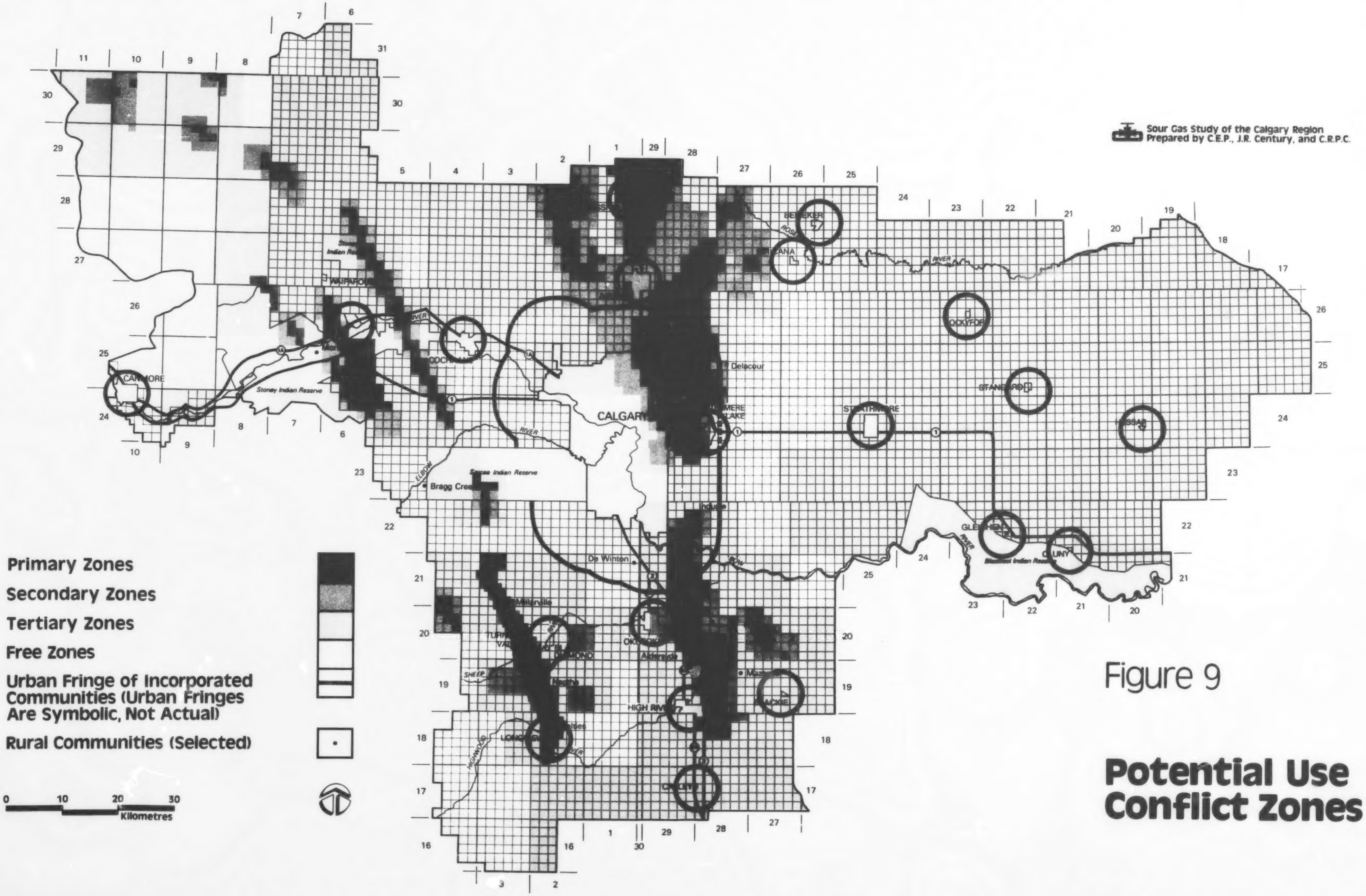
Primary Zones
Secondary Zones
Tertiary Zones
Free Zones
Urban Fringe of Incorporated Communities (Urban Fringes Are Symbolic, Not Actual)
Rural Communities (Selected)
0
10
20
30
Kilometres
CALGARY
CANMORE
COCHRANE
WAIPAROUS
Stoney Indian Reserve
Sarcee Indian Reserve
Blackfoot Indian Reserve
Bragg Creek
Delacour
CHESTERMERE LAKE
STRATHMORE
STANDARD
ROCKYFORD
BEISEKER
IRRICANA
AIRDRIE
GLEICHEN
CLUNY
De Winton
Millarville
TURNER VALLEY
DIAMOND VALLEY
OKOTOKS
Aldersyde
Mazeppa
BLACKIE
HIGH RIVER
LONGVIEW
CAYLEY
BOW RIVER
ELBOW RIVER
ROSEBUD RIVER
SHEEP RIVER
HIGHWOOD RIVER
1
1A
2
22

Figure 9

Potential Use Conflict Zones

Problems aften arise as a result of development taking place without liaison between municipalities, industry, regional planning commissions and the ERCB. Therefore, a co-ordinated effort and effective information exchange is the first imperative step toward reasonable co-existence.

Under the guidelines and regulations in place, industry provides the municipalities with several opportunities to comment on the location and type of proposed developments as well as the opportunity for input on Emergency Response Plans. The various means of public input are as follows:

Firstly, the operator would approach the landowner in an attempt to acquire approval to construct a facility on the landowner's property. As mentioned previously, if approval cannot be achieved then the ERCB intervenes as a negotiating body.

Also, the ERCB's Interim Directive ID 81-4 ensures that municipal administrators are made aware of wells or pipelines proposed near cities, towns or villages.

The terms of reference of this Interim Directive do not include gas distribution lines that will operate at 700 kPa or less. In addition, licence and permit applications for wells and pipelines likely to produce or transport gas having a hydrogen sulphide content of greater than 10 moles per kilomole are dealt with in Interim Directives ID 87-2 and ID 81-3 respectively. For sour gas pipelines, all residents within the setback are notified.

Secondly, should any objection to the proposed facility be brought forth or should concerns expressed be unresolved, the ERCB would set a hearing. Land use planning agencies are entitled to make representation to the ERCB on any land use implications of the application. A written submission is required to be filed with the ERCB prior to the hearing and the intervener is also given the opportunity to speak at the hearing.

Thirdly, regional planning commissions are notified of any applications of major concern such as pipelines and processing plants. This information can then be passed to the municipality, thereby providing the municipality with two or more sources of information on the application.

9.3 WHAT IS THE MUNICIPALITY'S RESPONSIBILITY?

With regard to planning around existing or future sour gas facilities, the municiplity has a responsibility to both its residents and to the operator. Firstly, it is the municipality's responsibility to provide additional safeguards for the community against the possible dangers of the sour gas industry. This can be accomplished by integrating the existing process, as set out by Provincial guidelines and regulations, into the municipal planning and development process. Secondly, in order to ensure a reasonable co-existence, the municipality also has the responsibility of informing the operator of future municipal plans that may create conflict, providing reasonable suggestions to minimize existing conflicts and, where pipeline rights-of-way or well leases exist within incorporated boundaries, ensuring that the potential for third party damage is minimized.

9.4 GUIDELINES FOR MUNICIPAL USE

The following are general guidelines for municipalities which may assist in minimizing conflicts with existing or future sour gas development and working toward a reasonable co-existence. These guidelines are intended to simply provide suggestions for improving the process already in place and rely on municipal planning prerogatives for implementation.

- Municipalities should include maps illustrating sour gas well locations, pipeline routes and processing plant locations in municipal planning documents. Obtaining current and updated mapping through the ERCB can be an unweildly task for a municipality though, as the data changes daily in some cases. The

Regional Planning Commission, could assist with this task. In all instances the mapping should also include the appropriate setback distances relating to the facility level rating as set out in ID 81-3 for pipelines and ID 87-2 for wells. This will act as a general guideline for planning and site specific applications for development that may fall within the setback area.

- When an urban municipality is informed by the operator of proposed sour or sweet gas development as outlined in ID 81-4, the municipality should be prepared to respond. This information exchange should be viewed as a medium for negotiation and with proper consultation between both the operator and the municipality, the need for a hearing may be avoided. It should be noted that the ERCB provides assistance in negotiating municipal concerns. Also, assistance from the Regional Planning Commission is available to municipalities when preparing an informal response or a submission to an ERCB hearing.

- In responding to proposals for sour gas development in or adjacent to a municipality, the municipality should be as specific as possible. That is, information on future growth areas, any plans or proposals to redefine the Urban Fringe Part and areas of existing or potential concern should be identified. Also, provide questions to ask the operator and provide some suggestions for minimizing potential impacts. Some questions to ask might be:

  - ° In addition to the Facility Level Rating and setback suggested, where would the Emergency Planning Zone extend?
  - ° Does the municipality have a hospital, school, nursing home, fire station, etc. in the anticipated Emergency Planning Zone? If so, what can be done to protect these facilities?
  - ° What would be the feasibility of relocating the facility (particularly related to pipelines)?

- How would the proposed facility fit with any Area Structure Plans in place for the area?
- Could these Area Structure Plans still be implemented keeping in mind the location of the proposed facility and setbacks?
- How will the proposed facilities effect future plans for annexation?
- How will the proposed facility affect the location of future utility servicing and the integrity of existing services?
- In the event of an uncontrolled release of sour gas, how will the Emergency Response Plan for the operator integrate with the local Disaster Services Plan?

These are just an example of some of the questions that a municipality should be attempting to answer or put to the operator or ERCB. These questions can be incorporated in designing the Emergency Response Plan.

- Another way in which a municipality can strive toward a more compatible co-existence with the sour gas industry is to plan for the possibility of sour gas facilities being incorporated in municipal expansion areas. With the life of most facilities being a minimum of 20 years and with urban expansion increasing, the problem of potential conflict is apparent. Also plan for how abandoned facilities will be integrated into future expansion plans. Abandoned facilities and Level 1 Facilities can be integrated, if necessary, with adjoining land uses through subdivision design and legal designation; keeping in mind that ample room around the facility should be maintained in order to accommodate servicing.

Although the setbacks outlined in the Subdivision Regulation and in the ERCB Interim Directives ID 87-2 and ID 81-3 (see Appendix 2) do not apply to development other than subdivision, it is recommended that municipalities utilize these setbacks when granting development permits for uses which would infringe upon the established right-of-way or would affect future changes to the facility level rating and setbacks.

- The location of existing sour gas facilities and information regarding proposed facilities should be one of the governing factors in negotiating Urban Fringe boundaries.

An ERCB decision on whether a facility will be located in the Urban Fringe of a municipality typically depends on the following factors:

- type of facility (Facility Level Rating 1 to 4),
- compliance with setback distances, and
- specific information on growth strategies, development plans, etc. provided by the municipality.

- The hearing process, which is employed when unresolved conflicts occur, allows land use planning agencies to make representation on land use planning matters. The presentation of well organized, specific information can assist the ERCB in ensuring that the proposed facility does not jeopardize municipal growth, development or safety.

- To conclude, the best way to ensure that municipal interests are maintained is through effective communication between the municipality, operator, Regional Planning Commission and ERCB. The preceeding comments are general in nature and designed to illustrate the means available to the municipality for presenting its concerns and therefore ensuring the best possible protection of its interests.

The following are more specific examples of the types of policies that could be integrated into municipal planning documents should the municipality feel it is appropriate. These are in no way to be considered complete and should be evaluated to meet individual municipal requirements.

- Municipalities could have policy positions which provide procedures and criteria on how to deal with sour gas facility application referrals. This could include:

  - the method of response (letter or standard form)
  - the specific information the municipality wishes to provide the operator with on proposed growth and development strategies
  - the questions that should be asked of the operator under all conditions
  - specific concerns regarding residential, commercial or industrial land uses in proximity to the facility as well as utility servicing concerns and health and safety concerns.

A standard checklist of questions could be developed. For example:

- The location of facilities and their separation distances as per the Subdivision Regulations or ID 81-3 and ID 87-2 should be incorporated into municipal planning documents.

- Local planning documents should include a contact list of operators in the municipality and establish criteria for a referral system. That is, the municipalities should make the operators aware of local development plans and changes in land use designations.

- Where areas adjacent to pipeline rights-of-way are subject to development pressure, the municipality should ensure via policies in local planning documents, that access is unobstructed and that additional signage be provided if necessary. It should be noted that operators are required to post warning signs at various intervals and when the pipeline crosses a highway, road, rail line or watercourse.

- The sour gas referral process for subdivision applications is the only formal referral process to the ERCB. That is, the subdivision approving authority is required to send a copy of the subdivision application to the ERCB if the affected parcel is within 1.5 km of any sour gas facility, including pipelines. As mentioned in a previous section of this guide, this is being done by those municipalities with subdivision approving authority in the Region. In turn, the ERCB provides the subdivision approving authority with the location and rating of the facilities on the subject land and surrounding area and advises on the appropriate separation distance.

- Local planning documents could contain policies to ensure that:

  ° the separation distances as set out for specific Facility Level Ratings in the Subdivision Regulation or ID 81-3 and ID 87-2 are adhered to, and

  ° proposed subdivisions and developments within or adjacent to the separation distance should be referred to the ERCB.

10.0 FOOTNOTES

[1] Communication with the Development Department Well Licencing Section, Energy Resources Conservation Board, February 1986.

[2] Communication with the Pipeline Department, Energy Resources Conservation Board, December 1985.

[3] Communication with the Gas Plant Approvals Department, Energy Resources Conservation Board, February 1986.

[4] Ibid.

[5] Energy Resources Conservation Board, ERCB Report 82-D, Sour Gas Processing in Alberta, April 1982.

[6] Communication with S. Slymon and B. MacKay, Field Office, Energy Resources Conservation Board, September 1985.

[7] Communication with S. Slymon, Field Office, Energy Resources Conservation Board, December 1985.

[8] Energy Resources Conservation Board, ERCB Report 82-D, Sour Gas Processing in Alberta, April 1982.

[9] Ibid.

[10] Opcit.

[11] Communication with Field Office, Energy Resources Conservation Board, December 1985.

[12] Alberta Agriculture, Negotiating Surface Rights, Agdex 878-1, pp. 1-4.

[13] Communication with Ron Paulson, Development Department (Lease Agreements), Energy Resources Conservation Board, January 1986.

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18 R.S.A., 1970 C. 276, S. 5, 1979, C. 56, S. 2 - Oil and Gas Conservation Act, 1980.

19 Canadian Petroleum Association, An Industry Guide for Emergency Procedures Planning for Drilling, Completion and Testing of Sour Gas Wells (draft), July 1985, p. 28.

20 Ibid.

21 Government of Alberta, Peacetime Emergency Operations Plan for a Sour Gas Release, Annex E, May 1985.

22 Energy Resources Conservation Board, Emergency Procedures Plan for Sour Gas Facilities (draft), Environmental Protection Policy Guide, Calgary, May 1984.

23 Communication with D. Beamer and W. Thorne, Environment Protection Department, Energy Resources Conservation Board, December 1985.

24 Opcit.

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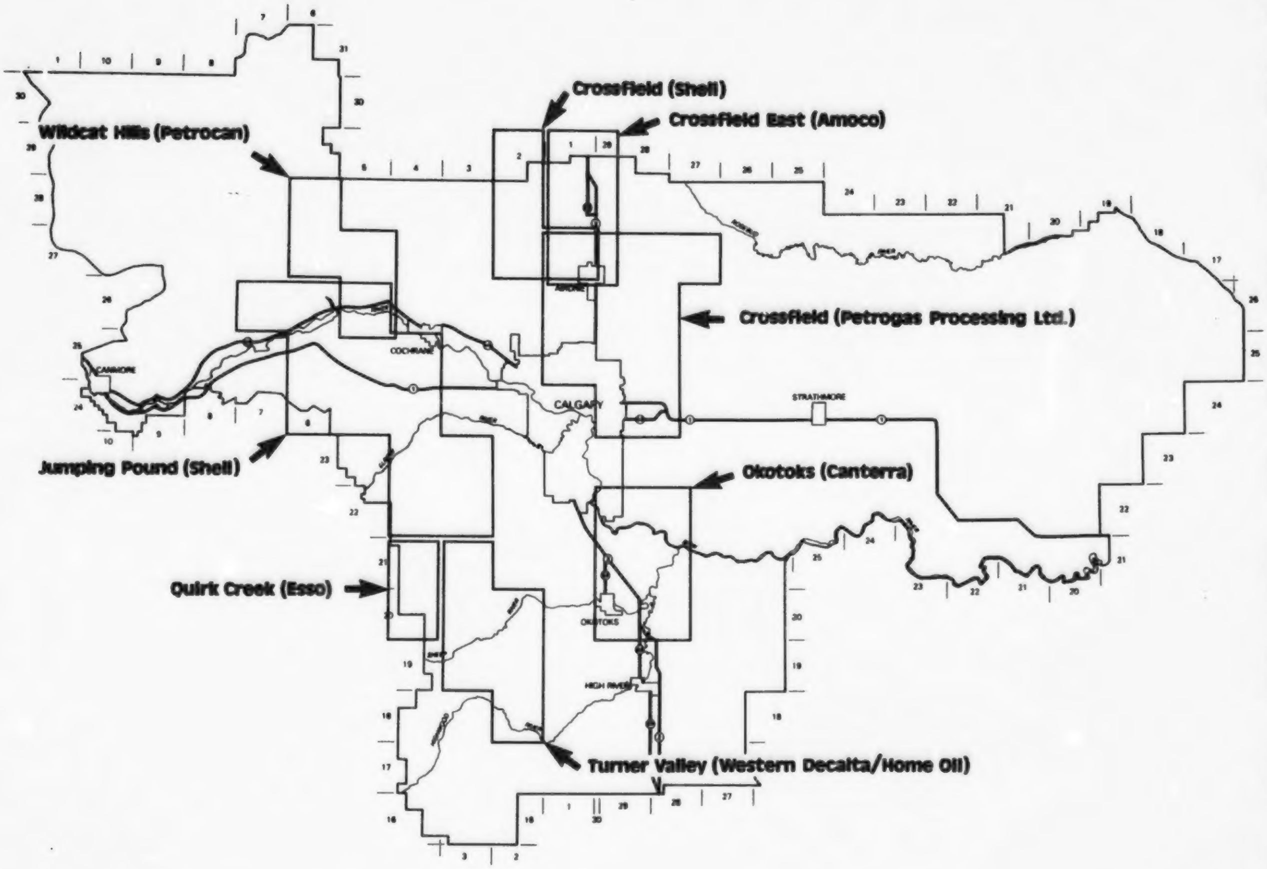
APPENDIX 1

Pipeline Systems and Separation Distances in the Calgary Region

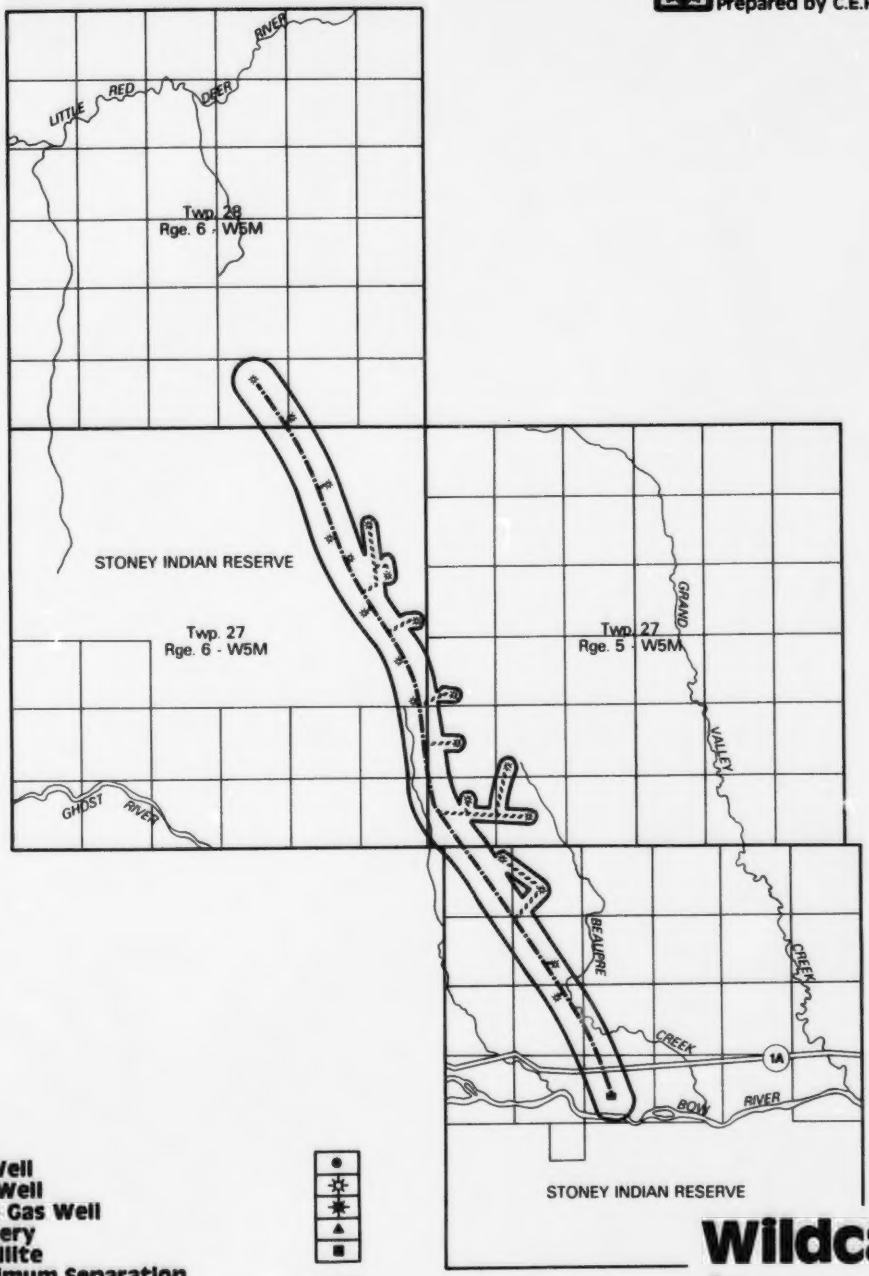

Crossfield (Shell)
Crossfield East (Amoco)
Wildcat Hills (Petrocan)
Airdrie
Crossfield (Petrogas Processing Ltd.)
Cochrane
Canmore
Calgary
Strathmore
Jumping Pound (Shell)
Okotoks (Canterra)
Quirk Creek (Esso)
Okotoks
High River
Turner Valley (Western Decalta/Home Oil)

Outline of Operators System

Pool (Operator)

Index to Pipeline System Maps

0 20 40 60
Kilometres

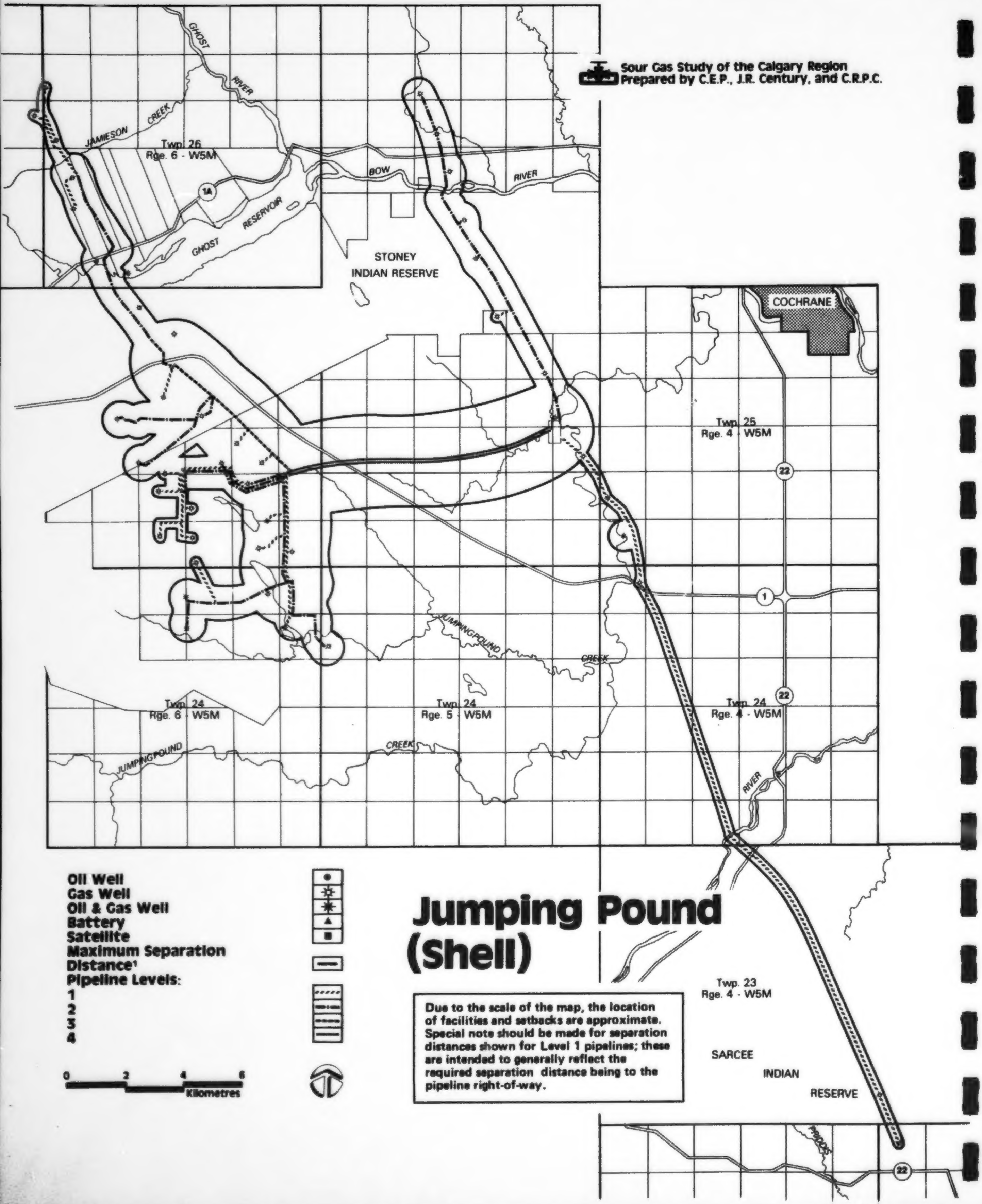

LITTLE RED DEER RIVER
Twp. 28
Rge. 6 - W5M
STONEY INDIAN RESERVE
Twp. 27
Rge. 6 - W5M
Twp. 27
Rge. 5 - W5M
GRAND VALLEY
GHOST RIVER
BEAUPRE
CREEK
CREEK
1A
BOW RIVER
STONEY INDIAN RESERVE

Wildcat Hills (Petrocan)

Oil Well ●
Gas Well ☼
Oil & Gas Well ✷
Battery ▲
Satellite ■
Maximum Separation Distance[1] ⊟
Pipeline Levels:
1 ┅┅
2 ─·─
3 ══
4 ═══

0 2 4 6
Kilometres

Due to the scale of the map, the location of facilities and setbacks are approximate. Special note should be made for separation distances shown for Level 1 pipelines; these are intended to generally reflect the required separation distance being to the pipeline right-of-way.


Sour Gas Study of the Calgary Region
Prepared by C.E.P., J.R. Century, and C.R.P.C.
GHOST
RIVER
JAMIESON
CREEK
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Rge. 6 - W5M
BOW
RIVER
1A
GHOST
RESERVOIR
STONEY
INDIAN RESERVE
COCHRANE
Twp. 25
Rge. 4 - W5M
22
1
JUMPINGPOUND
CREEK
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Rge. 5 - W5M
Twp. 24
Rge. 4 - W5M
22
JUMPINGPOUND
CREEK
RIVER
Twp. 23
Rge. 4 - W5M
SARCEE
INDIAN
RESERVE
PRIDDIS
22
Oil Well ●
Gas Well ☼
Oil & Gas Well ✷
Battery ▲
Satellite ■
Maximum Separation Distance¹
Pipeline Levels:
1
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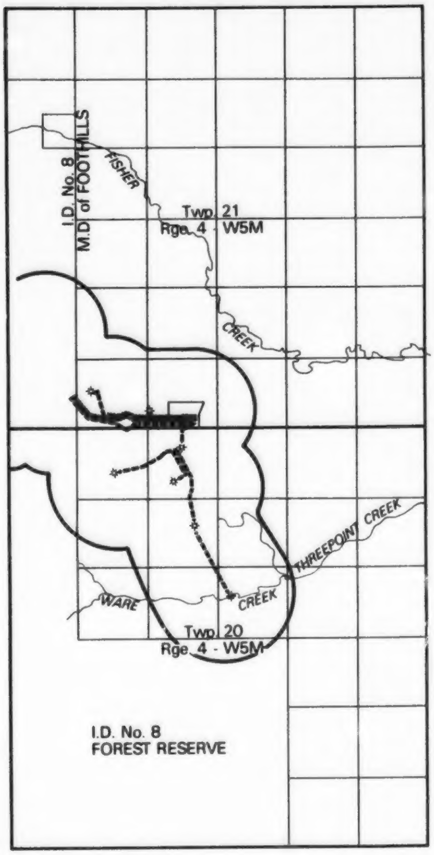
6
Kilometres

Jumping Pound (Shell)

Due to the scale of the map, the location of facilities and setbacks are approximate. Special note should be made for separation distances shown for Level 1 pipelines; these are intended to generally reflect the required separation distance being to the pipeline right-of-way.


I.D. No. 8
M.D. of FOOTHILLS
FISHER
CREEK
Twp. 21
Rge. 4 - W5M
THREEPOINT CREEK
WARE
CREEK
Twp. 20
Rge. 4 - W5M
I.D. No. 8
FOREST RESERVE

Oil Well	●
Gas Well	☼
Oil & Gas Well	✸
Battery	▲
Satellite	■
Maximum Separation Distance[1]	▭
Pipeline Levels:	
1	┅
2	-·-
3	- - -
4	—

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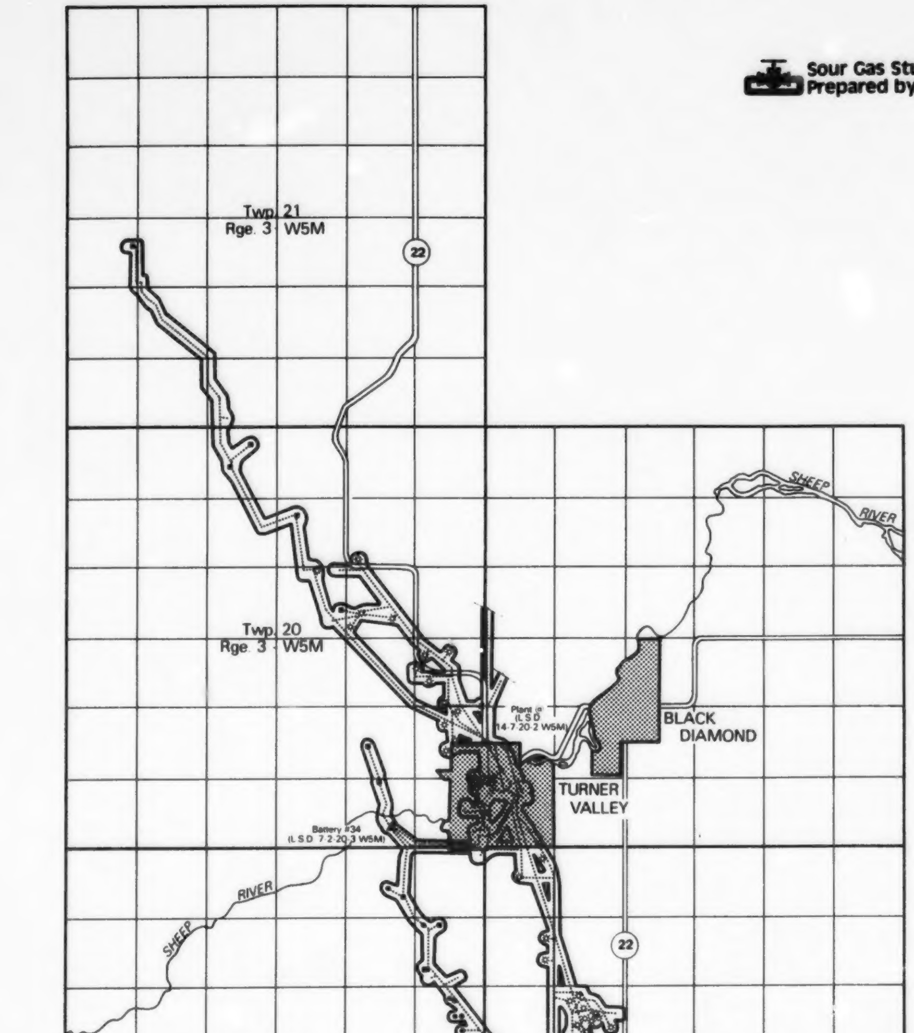
4
6
Kilometres

Quirk Creek (Esso)

Due to the scale of the map, the location of facilities and setbacks are approximate. Special note should be made for separation distances shown for Level 1 pipelines; these are intended to generally reflect the required separation distance being to the pipeline right-of-way.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SHEEP RIVER
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Plant @ (LSD 14-7-20-2 W5M)
BLACK DIAMOND
TURNER VALLEY
Battery #34 (LSD 7-2-20-3 W5M)
RIVER
SHEEP
22
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Rge. 3 · W5M
Twp. 19
Rge. 2 · W5M
Battery #13 (LSD 16-7-19-2 W5M)
Battery #27 (LSD 15-29-18-2 W5M)
Battery #8 (LSD 15-17-18-2 W5M)
LONGVIEW
HIGH WOOD
Oil Well ●
Gas Well ☼
Oil & Gas Well
Battery ▲
Satellite S
Maximum Separation Distance¹
Pipeline Levels: 1
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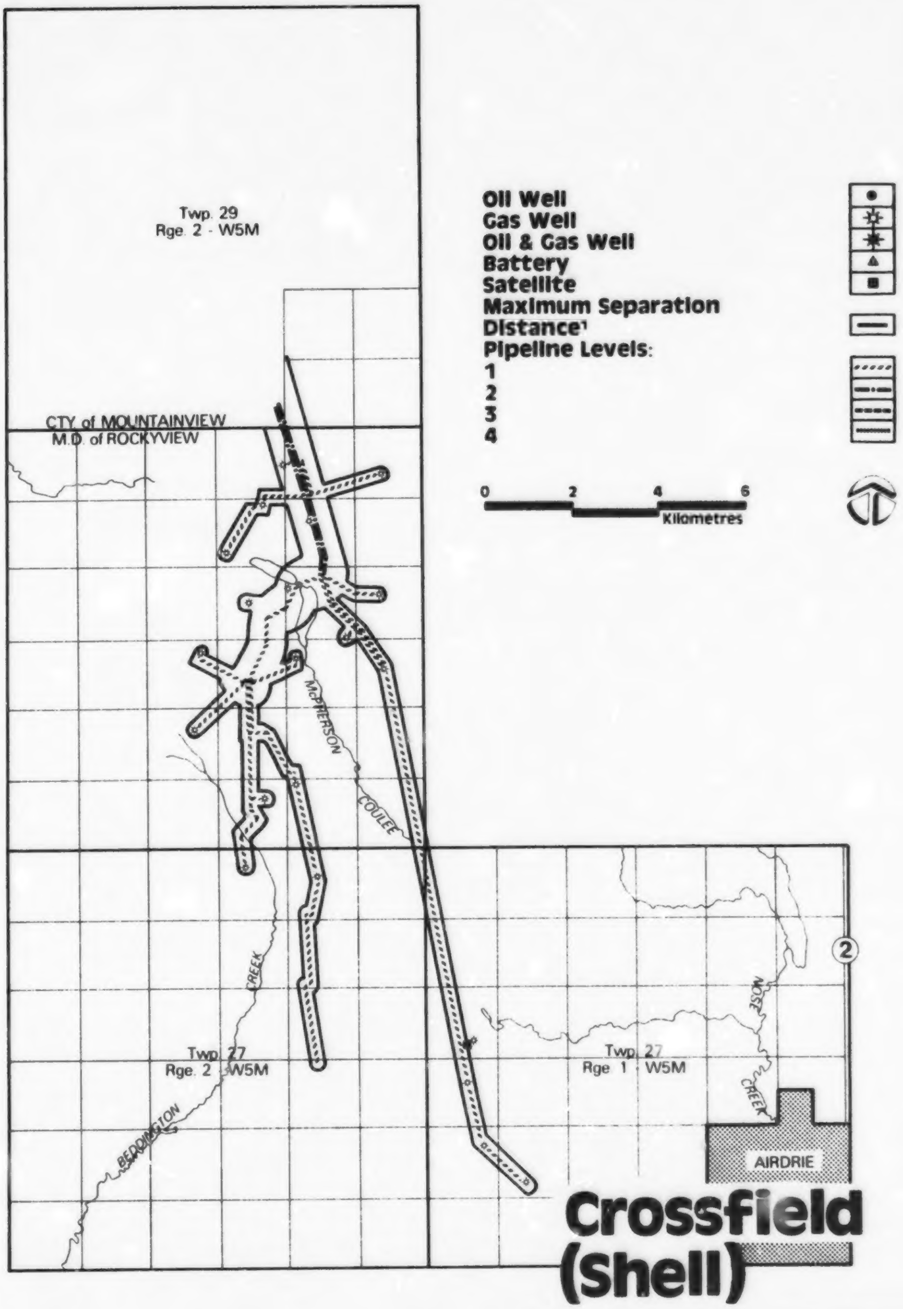
6
Kilometres

Turner Valley (Western Decalta/ Home Oil)

Due to the scale of the map, the location of facilities and setbacks are approximate. Special note should be made for separation distances shown for Level 1 pipelines; these are intended to generally reflect the required separation distance being to the pipeline right-of-way.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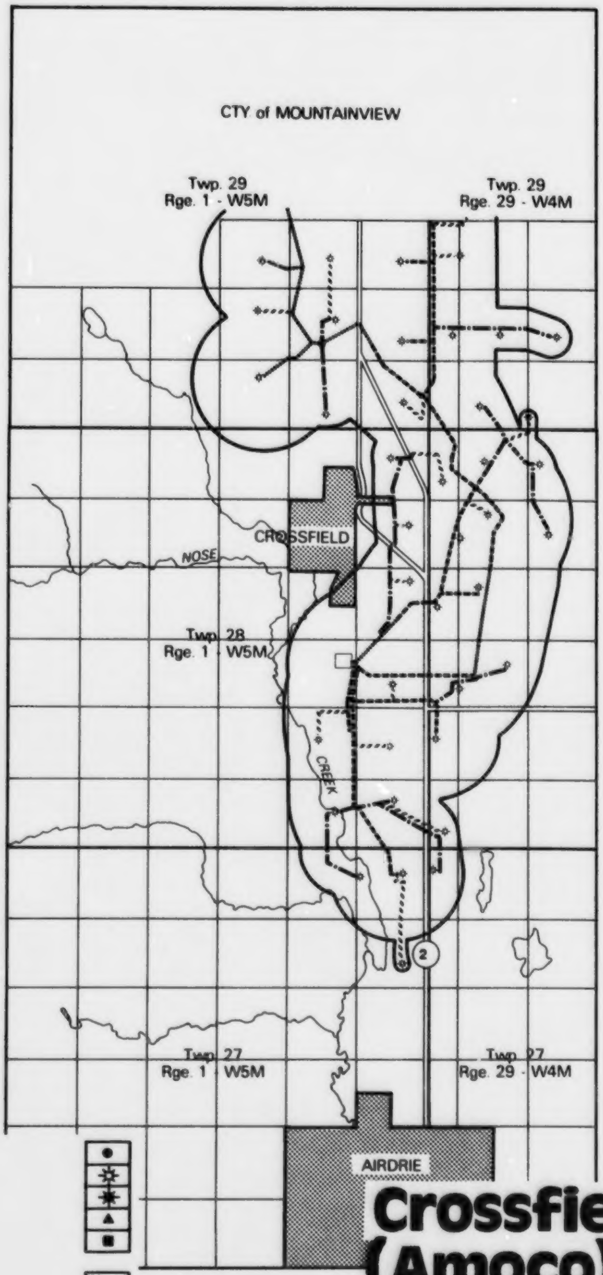
M.D. of ROCKYVIEW
McPHERSON
COULEE
CREEK
BEDDINGTON
Twp. 27
Rge. 2 - W5M
Twp. 27
Rge. 1 - W5M
NOSE
CREEK
AIRDRIE
2
Oil Well
Gas Well
Oil & Gas Well
Battery
Satellite
Maximum Separation Distance¹
Pipeline Levels:
1
2
3
4
0
2
4
6
Kilometres
Crossfield
(Shell)

Due to the scale of the map, the location of facilities and setbacks are approximate. Special note should be made for separation distances shown for Level 1 pipelines; these are intended to generally reflect the required separation distance being to the pipeline right-of-way.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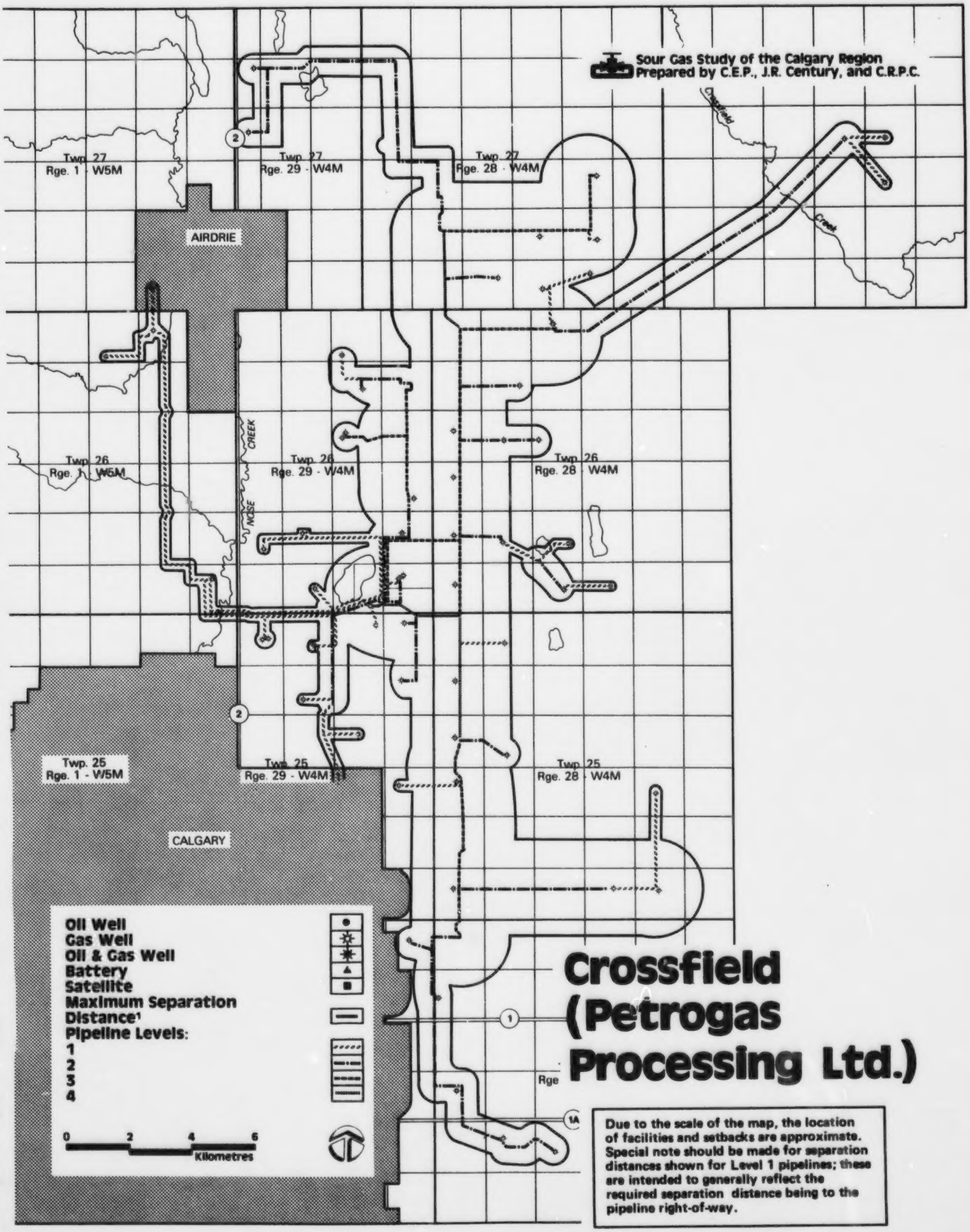
Rge. 29 - W4M
CROSSFIELD
NOSE
Twp. 28
Rge. 1 - W5M
CREEK
2
Twp. 27
Rge. 1 - W5M
Twp. 27
Rge. 29 - W4M
AIRDRIE

Oil Well	●
Gas Well	☼
Oil & Gas Well	✷
Battery	▲
Satellite	■
Maximum Separation Distance[1]	▭
Pipeline Levels:	
1	┄┄┄
2	—·—
3	╌╌╌
4	───

0 2 4 6
Kilometres

Crossfield East (Amoco)

Due to the scale of the map, the location of facilities and setbacks are approximate. Special note should be made for separation distances shown for Level 1 pipelines; these are intended to generally reflect the required separation distance being to the pipeline right-of-way.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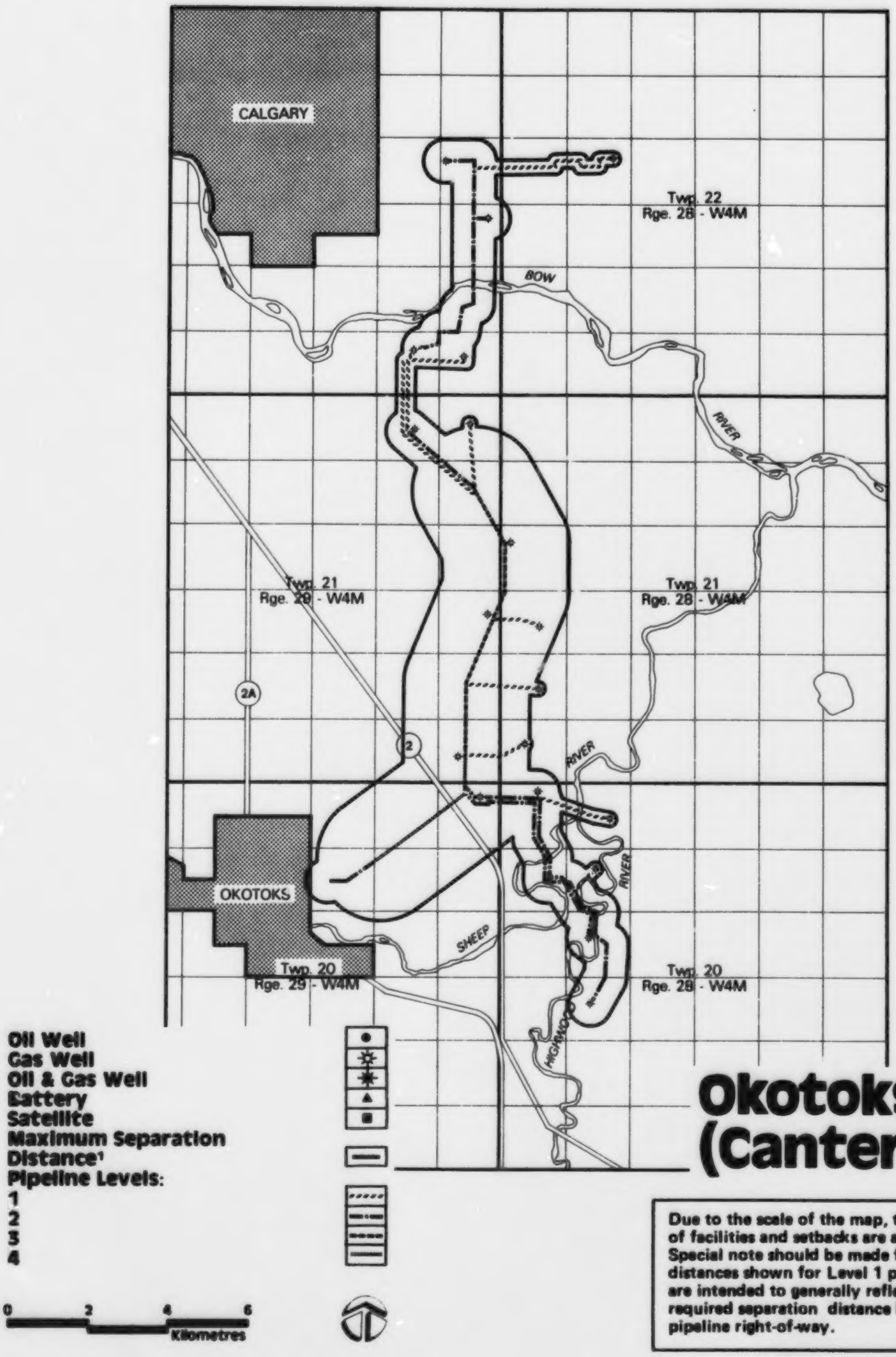
Twp. 27 Rge. 1 - W5M
Twp. 27 Rge. 29 - W4M
Twp. 27 Rge. 28 - W4M
Crossfield
Creek
AIRDRIE
CREEK
NOSE
Twp. 26 Rge. 1 - W5M
Twp. 26 Rge. 29 - W4M
Twp. 26 Rge. 28 - W4M
Twp. 25 Rge. 1 - W5M
Twp. 25 Rge. 29 - W4M
Twp. 25 Rge. 28 - W4M
CALGARY
2
2
1
1A
Rge
Oil Well ●
Gas Well ☼
Oil & Gas Well ✷
Battery ▲
Satellite ■
Maximum Separation Distance¹
Pipeline Levels:
1
2
3
4
0 2 4 6
Kilometres

Crossfield (Petrogas Processing Ltd.)

Due to the scale of the map, the location of facilities and setbacks are approximate. Special note should be made for separation distances shown for Level 1 pipelines; these are intended to generally reflect the required separation distance being to the pipeline right-of-way.


CALGARY
Twp. 22
Rge. 28 - W4M
BOW
RIVER
Twp. 21
Rge. 29 - W4M
Twp. 21
Rge. 28 - W4M
2A
2
RIVER
OKOTOKS
SHEEP
RIVER
HIGHWOOD
Twp. 20
Rge. 29 - W4M
Twp. 20
Rge. 28 - W4M
Oil Well
Gas Well
Oil & Gas Well
Battery
Satellite
Maximum Separation Distance¹
Pipeline Levels:
1
2
3
4
0
2
4
6
Kilometres

Okotoks (Canterra)

Due to the scale of the map, the location of facilities and setbacks are approximate. Special note should be made for separation distances shown for Level 1 pipelines; these are intended to generally reflect the required separation distance being to the pipeline right-of-way.

APPENDIX 2

The Energy Resources Conservation Board Interim Directive ID 87-2 and ID 81-3
(Facility Level Ratings and Separation Distances for Sour Gas Wells, Pipelines and Plants)

The Energy Resources Conservation Board Interim Directive ID 81-4
(Wells Near Urban Centres)

ERCB

Energy Resources
Conservation Board

640 Fifth Avenue SW
Calgary, Alberta
Canada T2P 3G4

Interim Directive

ID 87-2

ALGARY REGIONAL PLANNING COMMISSION
RECEIVED
JUN 23 1987

TO: All Operators and Drilling Contractors

SOUR WELL LICENSING AND DRILLING REQUIREMENTS

This directive replaces and consolidates the requirements of Draft Interim Directive ID 84-*, Interim Directive ID 81-3, and Interim Directive ID-OG 76-2 as they apply to the licensing and drilling of sour wells. Future directives will address requirements for completing, servicing, and producing "critical sour wells"** and the separation distance requirements for locating sour pipelines and associated facilities. Sections 1 to 7 set out procedures and requirements for licensing all sour wells and the special requirements for those which require an emergency response plan or are classified as critical sour wells.

The requirements of this directive are in addition to those set out in the Oil and Gas Conservation Act, the Oil and Gas Conservation Regulations, and Guide G-33, Application for a Well Licence.

Applicants requiring assistance or further information regarding this directive should contact the Development Department at 297-8159 or alternatively 297-8186.

ISSUED at Calgary, Alberta, on 3 June 1987.

G J DeSorcy

G. J. DeSorcy
Chairman

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* This and other documents are identified in Appendix 2.
** This and other terms are defined in Appendix 1.

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1 WELLS EXEMPT FROM HYDROGEN SULPHIDE (H_2S) RELEASE RATE SUBMISSION REQUIREMENTS

1.1 Introduction

This directive sets out guidelines for the evaluation of potential H_2S release rates* for wells to be drilled in Alberta. This section outlines areas and conditions under which an applicant would or would not be exempt from the general requirements to evaluate the potential H_2S release rate of a proposed well.

A generalized evaluation of geological formations throughout Alberta has shown that the H_2S release potential increases as the age of the formation increases and as the depth of a given formation increases. The survey shows that:

(1) Formations above the Mannville Group contain little or no H_2S.

(2) Some reservoirs in the Mannville Formation contain varying small amounts of H_2S in scattered areas throughout the province with potential H_2S release rates up to 0.1 cubic metres per second (m^3/s).

(3) Some reservoirs in Jurassic and Triassic formations also contain small amounts of H_2S but these formations are of limited distribution.

(4) Mississippian and Devonian formations are of principal concern as they have the potential for significant H_2S concentrations and reservoir flow capability.

(5) H_2S release rates in the foothills/mountains area are less predictable due to the faulted nature of the region.

The results of this evaluation have satisfied the Board that exemptions from the requirement of submitting H_2S release rate data with the well licence application are appropriate for certain wells and that these exemptions can be implemented without compromising public safety.

1.2 Foothills/Mountains Area

Applicants of proposed wells within the foothills/mountains area, identified as Area A (cross-hatched) on the attached map (Figure 1-1), are not exempt from the requirement of submitting H_2S release rate and other data with the well licence application.

---

* This and other terms are defined in Appendix 1.

1.3 Exemption Criteria for Other Areas

Applicants are exempt from the requirements of sections 2, 4, 5, 6, and 7 of this directive provided that the proposed well satisfies one of the following exemption categories defined by area on the attached map.

Area B (dark grey)

Exempt if terminating no more than 15 metres (m) below the base of the Viking, Bow Island, Cadotte, Pelican, or Blackstone formations.

Area C (light grey)

Wells drilled to the formations indicated have exhibited maximum H_2S release rates up to 0.1 m^3/s.

(1) Exempt if terminating not more than 15 m below the base of the Viking, Bow Island, Cadotte, Pelican, or Blackstone formations.

(2) Exempt if terminating no more than 15 m below the Paleozoic unconformity and

  (a) greater than 500 m from the nearest dwelling or public facility, and

  (b) greater than 1.5 kilometres (km) from the nearest urban centre.

Area D (white area)

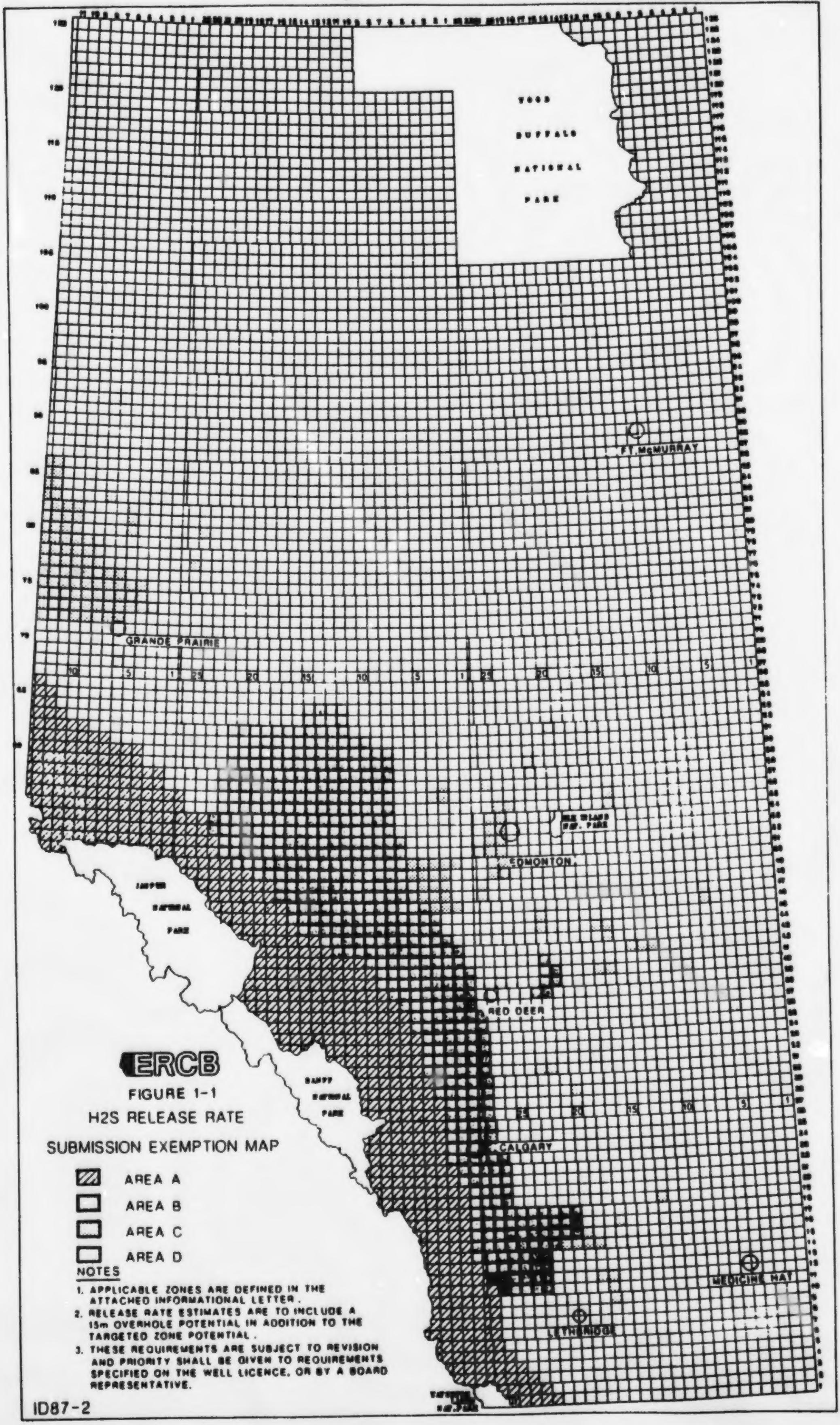
Wells drilled to the formations indicated have exhibited maximum H_2S release rates up to 0.01 m^3/s.

(1) Exempt if terminating not more than 15 m below the base of the Viking, Bow Island, Cadotte, Pelican, or Blackstone formations.

(2) Exempt if terminating not more than 15 m below the Paleozoic unconformity and

  (a) greater than 200 m from the nearest dwelling or public facility, and

  (b) greater than 1.5 km from the nearest urban centre.


WOOD BUFFALO NATIONAL PARK
FT. McMURRAY
GRANDE PRAIRIE
ELK ISLAND NAT. PARK
EDMONTON
JASPER NATIONAL PARK
RED DEER
BANFF NATIONAL PARK
CALGARY
MEDICINE HAT
LETHBRIDGE
WATERTON NAT. PARK
10
5
1
25
20
15
10
5
1
25
20
15
10
5
1

ERCB

FIGURE 1-1

H2S RELEASE RATE

SUBMISSION EXEMPTION MAP

▨ AREA A
☐ AREA B
☐ AREA C
☐ AREA D

NOTES

1. APPLICABLE ZONES ARE DEFINED IN THE ATTACHED INFORMATIONAL LETTER.
2. RELEASE RATE ESTIMATES ARE TO INCLUDE A 15m OVERHOLE POTENTIAL IN ADDITION TO THE TARGETED ZONE POTENTIAL.
3. THESE REQUIREMENTS ARE SUBJECT TO REVISION AND PRIORITY SHALL BE GIVEN TO REQUIREMENTS SPECIFIED ON THE WELL LICENCE, OR BY A BOARD REPRESENTATIVE.

ID87-2

2 PRE-APPLICATION SUBMISSIONS

2.1 Introduction

The filing of pre-application submissions for proposed sour wells* and particularly those which may be classified as critical sour wells is encouraged. This process can expedite the licensing of a sour well and avoid having to make major changes to an application because of revisions to the potential H_2S release rates. Information provided to the Board in a pre-application format will be held confidential and returned if requested.

2.2 Pre-application Submission Contents

Pre-application submissions (three copies) should contain the following:

(1) a discussion and supporting information which establishes the geological setting and prognosis of the proposed well,

(2) a discussion and supporting information respecting the H_2S content for each sour zone which may be encountered,

(3) a discussion and supporting information respecting the flow rates that may be expected from each potentially sour zone,

(4) calculation of the combined maximum potential H_2S release rate having regard for the drilling program and design of the well,

(5) a map or statement which locates the well in relationship to dwellings, public facilities, and urban centres and a statement respecting the probable public sensitivity of the well, and

(6) a statement advising the Board of the applicant's position respecting the critical or non-critical classification of the proposed well.

The above information will be considered by Board staff and its recommendations respecting the classification of the proposed well communicated to the applicant. If requested, the staff will meet with the applicant to discuss its findings.

---

* This and other terms are defined in Appendix 1.

3 APPLICATION REQUIREMENTS - ALL WELLS

3.1 Introduction

The Board expects companies to evaluate the potential of every well to penetrate formations which may contain H_2S and to plan for safe drilling operations consistent with the nature of occurrences and the potential H_2S release rate*. Each application for a well licence must provide the results of that evaluation and the information that is applicable. The degree of detail required to support the application will vary depending on the risk and consequences of a blowout at the proposed well.

Information provided the Board in response to the requirements of sections 3 to 7 inclusive of this directive will, with certain exceptions, be considered public information. Where geological data or personal information respecting individuals is provided as part of an application, the Board will, on request by the applicant, consider it as confidential. Such information should be included in a separate volume to avoid inadvertent disclosure.

In situations where an application goes to a public hearing the disposition of the matter will be decided on the basis of only that information which is public. However, the applicant will be provided with an opportunity to reclassify as public information all or a modified part of the data originally filed as confidential.

3.2 Application Requirements

Applications for all well licences must include one of the following:

(1) a statement, and supporting evidence if appropriate, to the effect that none of the formations to be encountered during the drilling of the well are expected to contain H_2S,

or

(2) a statement to indicate that the well is exempted by section 1 and a statement or map to show that the well is located more than the required distance to dwellings, public facilities, and urban centres,

or

(3) for wells which are expected to encounter sour gas and which are not exempted by section 1, the following:

---

* This and other terms are defined in Appendix 1.

(a) the potential H_2S release rate information described in section 4, and

(b) the minimum separation distance information described in section 5, and

(c) emergency response plan information described in section 6, and

(d) a critical sour well drilling plan described in section 7, if applicable.

4 POTENTIAL H_2S RELEASE RATE DETERMINATION

4.1 Introduction

A determination of the maximum potential H_2S release rate* forms the basis for further application requirements. It must be calculated from the maximum surface deliverability and the maximum H_2S content that can be reasonably expected. Evaluations should be done using a realistic geological-engineering assessment.

Information used should reflect all data from wells in the area which are considered to be representative of the subject well. It is emphasized that the expected geological setting and therefore potential of the well is very important to this process. It may not, for example, be appropriate to use adjacent wells if the geological evidence indicates a different potential. In such cases, it may be necessary to use data from an analog well or reservoir located some distance from the proposed well.

In some cases a range of release rates is acceptable - particularly where even in the lower end of the range a critical sour well classification is expected to result (section 7). Any uncertainty in the release rate would be considered in determining the appropriateness of components of the drilling and emergency response plans, and the ignition criteria in particular.

4.2 Drilling H_2S Release Rate

The drilling H_2S release rate is used to determine whether or not an emergency response plan is required (section 6) and whether or not the well is classified as a critical sour well (section 7).

Information required includes:

(1) For each formation to be penetrated which may contain H_2S,

  (a) the maximum concentration of H_2S that can be expected and the source of that information,

  (b) the maximum surface deliverability that can be expected against zero back pressure for the casing flow or open-hole flow configuration;

(2) The maximum potential uncontrolled surface H_2S release rate at that stage in the drilling of the well where the sum of the release rates from each formation open to the wellbore is at a maximum.

---

* This and other terms are defined in Appendix 1.

4.3 Suspended/Producing H_2S Release Rate

The suspended/producing H_2S release rate is used to determine the level classification and appropriate separation distance requirements of the well (section 5). Where stimulation is normal or expected, a post-stimulation rate should be used.

Information required includes:

(1) For each formation to be suspended/produced which may contain H_2S,

  (a) the maximum concentration of H_2S that can be expected and the source of that information,

  (b) the maximum surface deliverability that can be expected against zero back pressure for the tubing flow configuration for a well completed with a packer, or the tubing and annular flow configuration for a well completed without a packer if the well is capable of flowing up the annulus;

(2) The maximum potential uncontrolled surface H_2S release rate at that stage in the suspended/producing life of the well where the sum of the release rates for each formation open to the wellbore is at a maximum.

5 MINIMUM DISTANCE REQUIREMENTS SEPARATING PROPOSED SOUR WELLS FROM RESIDENTIAL AND OTHER DEVELOPMENTS

5.1 Introduction

In order to select appropriate well locations having regard for public safety and present and future land use, the Board has established the following level classification* for sour wells. Each level classification has corresponding minimum separation distances between sour wells and residential and other developments. The distances increase as the suspended/producing H_2S release rate potential (section 4.3) increases, and with increasing population density. Table 5-1 summarizes the separation distances for sour wells.

(a) Level 1 sour well: Any well with a maximum potential H_2S release rate of 0.01 m^3/s or greater and less than 0.3 m^3/s. All wells remain subject to section 2.110 of the Oil and Gas Conservation Regulations which require a 0.1-km separation distance between it and any surface improvement. The Board may specify some other separation distance for a Level 1 sour well should the circumstances warrant such action.

(b) Level 2 sour well: Any well with a maximum potential H_2S release rate of 0.3 m^3/s or greater and less than 2.0 m^3/s. A Level 2 sour well shall be located to provide 0.1-km separation distance between it and any dwelling, and 0.5-km separation distance between it and any urban centre or public facility.

(c) Level 3 sour well: Any well with a maximum potential H_2S release rate of 2.0 m^3/s or greater and less than 6.0 m^3/s. A Level 3 sour well shall be located to provide 0.1-km separation distance between it and any dwelling, 0.5-km separation distance between it and any unrestricted country development, and 1.5-km separation distance between it and any urban centre or public facility.

(d) Level 4 sour well: Any well with a maximum potential H_2S release rate of 6.0 m^3/s or greater. A Level 4 sour well shall be so located that as a minimum, it meets the requirements set out for a Level 3 sour well. However, the Board may require greater separation distances or set out other such requirements as it deems necessary.

With regard to encroachment of proposed surface development on existing sour wells, the Subdivision Regulations pursuant to the Planning Act reflect similar setbacks to the Board's separation distances.

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* This and other terms are defined in Appendix 1.

TABLE 5-1 SUMMARY OF MINIMUM DISTANCE REQUIREMENTS SEPARATING PROPOSED SOUR WELLS FROM RESIDENTIAL AND OTHER DEVELOPMENTS

Level Classification	Producing/Suspended H_2S Release Rate m^3/s (section 4.3)	Minimum Distance from Proposed Well to Various Developments
1	$\geqslant 0.01 - < 0.3$	0.1 km as stated in section 2.110 of the Oil and Gas Conservation Regulations
2	$\geqslant 0.3 - < 2.0$	0.1 km to any dwelling 0.5 km to any urban centre or public facility
3	$\geqslant 2.0 - < 6.0$	0.1 km to any dwelling 0.5 km to an unrestricted country development 1.5 km to an urban centre or public facility
4	$\geqslant 6.0$	As specified by the ERCB but not less than Level 3

NOTE: Any well classified as a Level 1, 2, 3, or 4 sour well may also be classified as a critical sour well (section 7).

5.2 Application Requirements

Information required includes:

(1) A plan or map showing

(a) the location of dwellings, unrestricted country residential development, or public facilities within

- 0.1 km of a Level 1 sour well,
- 0.5 km of a Level 2 sour well,
- 1.5 km of a Level 3 or 4 sour well,

(b) the location of any urban centres within 1.5 km of the proposed well;

or

(c) a statement, where appropriate, on the survey plan or elsewhere, that there are no dwellings, unrestricted country residential developments, public facilities, or urban centres within the distances specified in (a) and (b) above.

(2) For a Level 2, 3, or 4 well, a list showing names, addresses, and land descriptions of all owners whose property is, in whole or in part, within the distances specified in (1)(a) above.

All persons who may be directly and adversely affected by the proposed well must be given notice of the proposed drilling of the well. The Board may consider this requirement satisfied if the applicant is able to confirm that it has contacted all of the owners listed and that they have no objections to the proposed well.

(3) For a Level 2, 3, or 4 well, either

(a) an application for a permit for a pipeline to transport the sour gas to a processing plant or gathering system,

or

(b) a plan showing a potential pipeline route or alternative routes which would conform with the separation distances required for pipelines of the type required to carry produced fluids from the well.

6.0 SOUR WELL EMERGENCY RESPONSE PLANS

6.1 Introduction

The Board believes that operators must be prepared to ensure public safety in the event of a release of H_2S and expects operators to be prepared to deal with all emergencies that may occur at a well site. It has decided that certain sour wells*, generally those which exhibit a high H_2S release potential or those near dwellings, require site-specific emergency response plans which must be reviewed and approved by the ERCB. The Board's policy is to ensure that if there is a significant release of H_2S, the health and safety of the public must be protected either by their evacuation from the area or, if evacuation is not practical, by ignition of the well.

6.2 Application Requirements

The following information should be included with all well licence applications for wells expected to encounter sour gas and which are not exempted by section 1:

(1) A statement of the size (generally the radius) of the emergency planning zone determined by using the drilling H_2S release rate as determined in accordance with section 4.2 and Figure 6-1 or 6-1a of this directive.

(2) Where it appears that an emergency response plan will not be required (section 6.3.1), a statement of the distance to the nearest dwelling, public facility, and urban centre.

(3) A statement describing any public awareness program intended or undertaken, addressing in particular the nature and extent of communications with any urban centres or residents in the vicinity of the well.

6.3 Emergency Response Plan Requirements

6.3.1 When a Plan Is Required

An emergency response plan will be required for the drilling of a sour well when

(1) the well is classified as a critical sour well (section 7),

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* This and other terms are defined in Appendix 1.

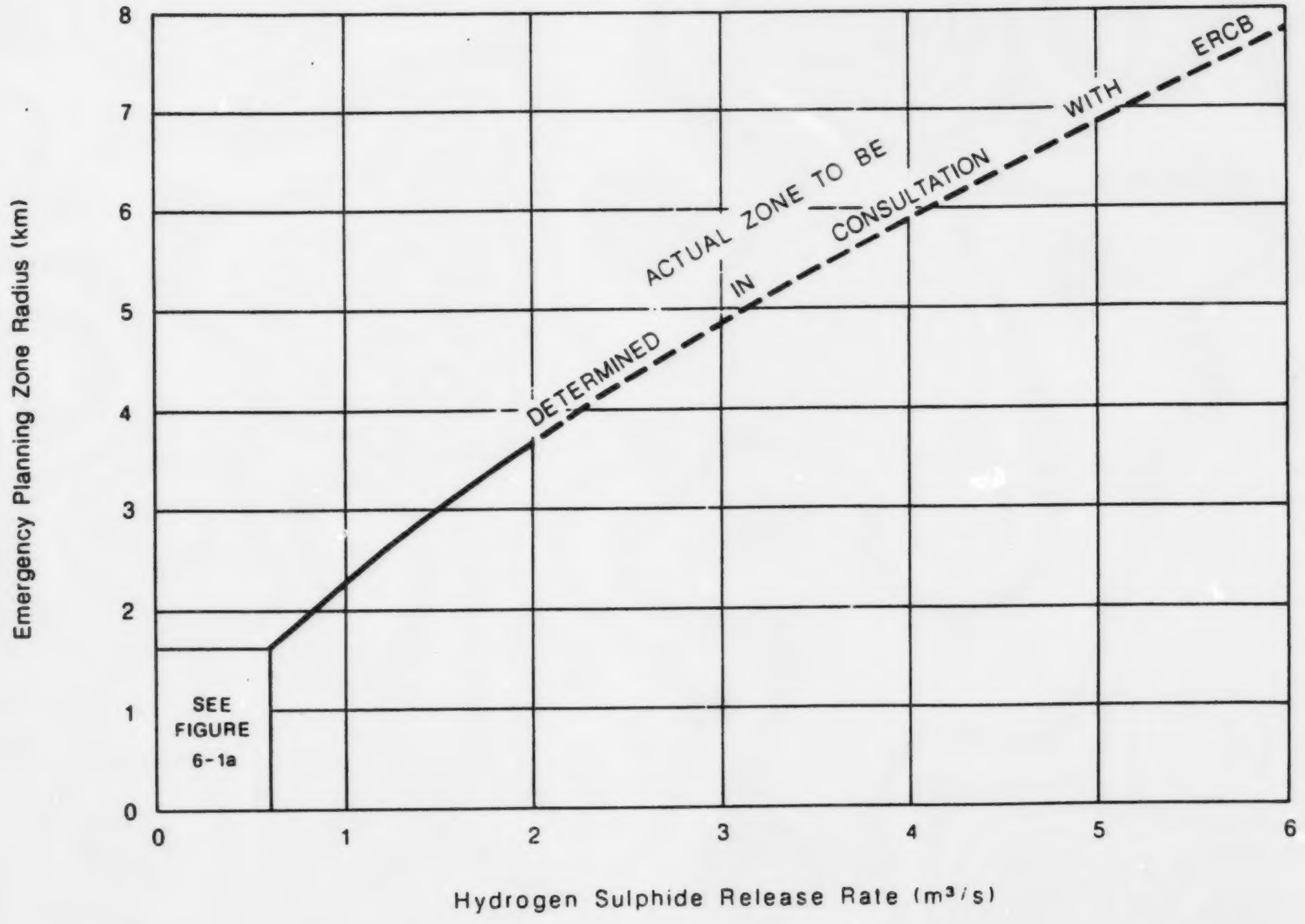

FIGURE 6-1 EMERGENCY PLANNING ZONE GUIDELINES FOR SOUR WELLS

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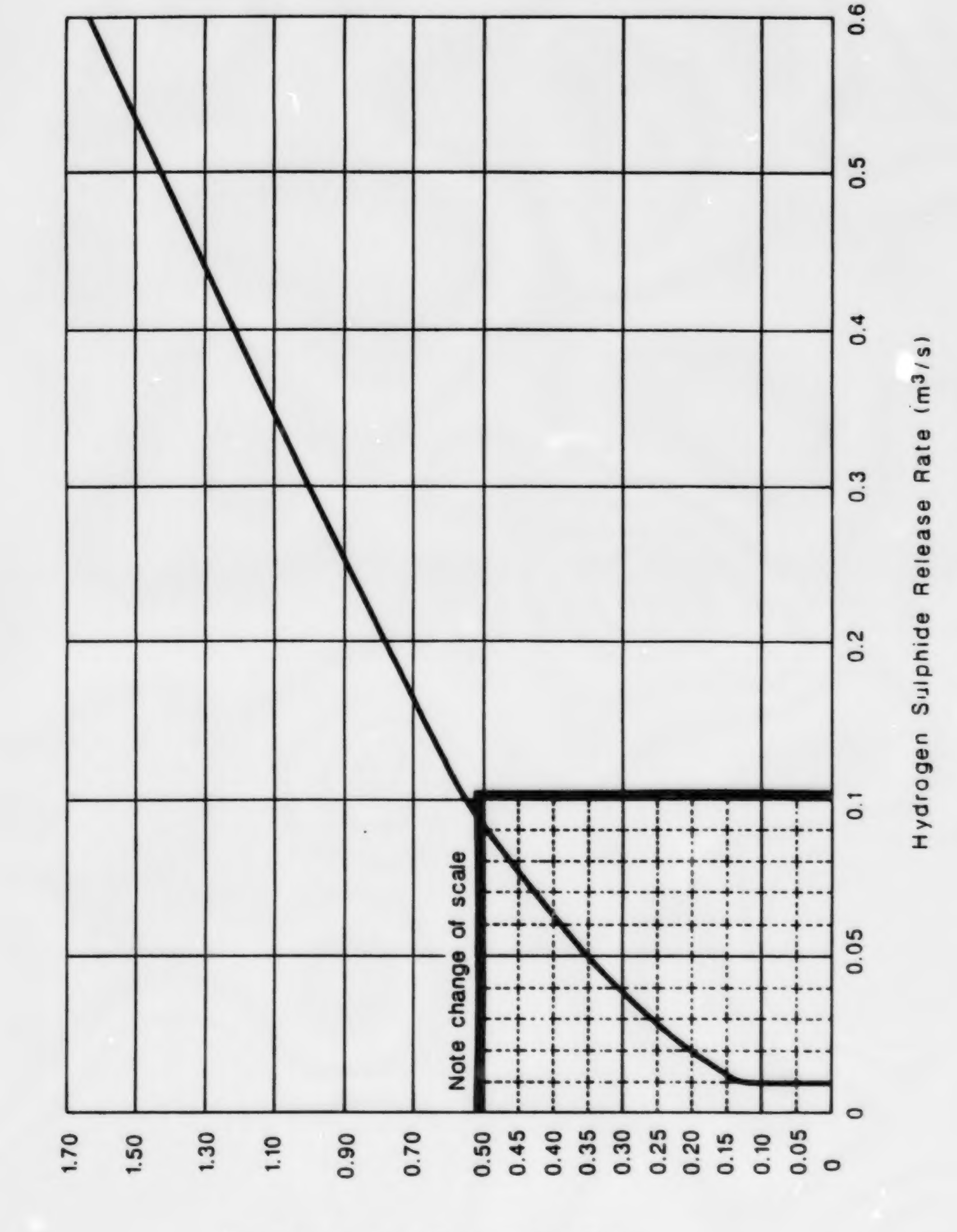

FIGURE 6-1a EMERGENCY PLANNING ZONE GUIDELINES FOR SOUR WELLS

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ERCB

(2) the well has one or more dwellings, public facilities, work sites, places of business, or similar activities within the emergency planning zone, or

(3) the Board decides that a plan is required for other reasons.

6.3.2 Selection of Emergency Planning Zone

The appropriate emergency planning zone must be carefully selected and must be adequate to ensure the safety of the public near the well. The size and shape of the zone must reflect the maximum drilling H_2S release rate but must also have regard for the local terrain and density of population in the area. Figures 6-1 and 6-1a provide guidelines for determining the size of emergency response plan zones.

Reduced planning zones will be considered by the Board for wells which exhibit very high H_2S release rate potential (+3.0 m^3/s) and which are near densely populated areas that may be difficult or impossible to evacuate in the event of an emergency. In such cases, the ignition criteria specified to ensure public safety must be appropriate for the reduced planning zone.

6.3.3 Emergency Plan Contents

The Canadian Petroleum Association has prepared "Guidelines for Preparation of Emergency Response Plans for Drilling, Completion and Testing of Sour Gas Wells". These guidelines have been reviewed by the Board and accepted as meeting the minimum standards for emergency response plans. However, the Board retains the right to decide the amount of detail required in each plan submitted for approval. The Board wishes to stress that each plan must consider site-specific circumstances. Variations in the plans can be expected based on factors such as the geological prognosis of the well, the population density and distribution, and the consequences of a blowout.

The Board stresses that public input from local residents and municipal administrators is an integral part of preparing an effective emergency response plan. In some instances it may be necessary to hold public meetings to obtain this input.

The minimum content and specific detail required in an emergency response plan is described in the CPA guide. Applicants are encouraged to use it but are not necessarily limited to following its format exactly. The following list identifies the major components and summarizes the key items to be addressed in a plan.

(1) Summary

This section is a summary of the key facts about the proposed well and the emergency response plan.

(2) Emergency Definition and Action

This section should describe the various circumstances that could lead to a sour gas release and the intended response. It defines the various stages of alert and describes the action for each stage. In addition it describes the responsibility of company and government personnel involved in an emergency.

(3) Evacuation Procedures

This section defines the criteria to be used to initiate an evacuation and describes how the evacuation would be carried out.

Details respecting the proposed air quality monitoring program and communication procedures are also addressed.

(4) Ignition Criteria

This section defines the ignition criteria and circumstances leading to the deliberate ignition of the well. Particular consideration is given to those cases where the size of the emergency planning zone has been reduced because of population density.

(5) Resident Information Package

This section includes a copy of the Resident Information Package that was or would be left with the residents within the emergency planning zone. The package provides a brief summary of the proposed well and operator, a summary of evacuation and ignition procedures, emergency telephone numbers, and a description of the hazards of H_2S and sulphur dioxide.

(6) Contact Information

This section provides a listing of the residents, company personnel, and government agencies that would be contacted in the event of a sour gas release.

(7) Maps

This section includes the maps necessary to show

(a) the selected emergency planning zone and the dwellings, other developments, roads, and topographical features within the zone;

(b) an area equal to at least twice the size of the emergency planning zone and the public facilities, urban centres, and evacuation routes within the area.

6.3.4 Specific Requirements

(1) When emergency response plans are required by the Board, they must receive approval from the Board's Environment Protection Department prior to licensing for critical wells, and prior to spudding for all other sour wells.

(2) A copy of the approved emergency response plan must be on site during all completion or servicing operations of designated wells. For drilling wells, the plan must be on the site prior to drilling out the surface casing.

(3) Copies of the approved emergency response plan must be sent to each of the following government departments or agencies:

(a) Alberta Environment
(b) Alberta Public Safety Services
(c) Workers' Health, Safety and Compensation
Occupational Health & Safety Division
(d) Appropriate Health Unit or local Board of Health
(e) Appropriate detachment of the RCMP
(f) Forestry, Lands and Wildlife (Crown land)
(g) Municipal governments, where applicable

(4) For critical sour wells, the operator shall hold a meeting to review the emergency response plan before drilling into the potential sour zones. The operator, its contractors, the ERCB, and the government departments and agencies listed in (3) above should attend.

(5) For wells with a high H_2S release potential and an emergency planning zone that includes all or a portion of an urban centre, continuous mobile monitoring will be required on lease during the drilling, servicing or completion of the potential sour zones. The need for continuous mobile electronic monitoring for other sour wells will be reviewed on a site-specific basis.

7 CRITICAL SOUR WELLS

7.1 Introduction

As a result of the Lodgepole blowout that occurred in the fall of 1982, the Board held an inquiry which was undertaken in two phases. Phase 1 (Decision D 84-9) investigated and reported on the blowout, its causes, and the events whch transpired during the 2.5 months the well was out of control. Phase 2 (Decision D 84-5) investigated ways to reduce the incidence of blowouts and to minimize their impact.

In conjunction with the Phase 2 decision report, the Board issued Draft Interim Directive ID 84-. This directive established a "critical sour well"* classification for certain sour wells in the province. The classification of critical sour wells is based on two primary criteria, H_2S release rate potential and proximity to populated centres.

A critical sour well includes

(1) any well from which the maximum potential H_2S release rate is 0.01 m^3/s or greater and less than 0.1 m^3/s and which is located within 500 m of the corporate boundaries of an urban centre, or

(2) any well from which the maximum potential H_2S release rate is 0.1 m^3/s or greater and less than 0.3 m^3/s and which is located within 1.5 km of the corporate boundaries of an urban centre, or

(3) any well from which the maximum potential H_2S release rate is 0.3 m^3/s or greater and less than 2.0 m^3/s and which is located within 5 km of the corporate boundaries of an urban centre, or

(4) any well from which the maximum potential H_2S release rate is 2.0 m^3/s or greater, or

(5) any other well which the Board classifies as a critical sour well having regard to the maximum potential H_2S release rate, the population density, the environment, the sensitivity of the area where the well would be located, and the expected complexities during the drilling phase.

7.2 Reclassification - Critical Sour Wells

A sour well, once classified as a critical sour well, will retain that classification as long as it is within the "critical period" as defined in Appendix 1. As a critical well it must meet all of the related operational and safety-related requirements set out in this directive. However, the Board will consider applications to remove the "critical" designation.

---

* This and other terms are defined in Appendix 1.

Applications to alter the "critical" designation assigned to a sour well shall be based on the most recent and complete information available at the time of application.

7.3 Critical Sour Well Application Requirements

The following requirements apply to the drilling of a well classified as a critical sour well. These requirements generally follow recommendations by the Blowout Prevention Review Committee (BPRC) set up as a result of the Lodgepole blowout inquiry. They will be incorporated as appropriate into the regulations. The BPRC also recommended the development and maintenance of Alberta Recommended Practices (ARPs) to provide advice to operators about the drilling of critical sour wells. The BPRC stated that "...although strict legal enforcement of good practices is not desired or possible the BPRC believes that such practices place considerable onus on the legally responsible party to comply or otherwise provide a technically equivalent or better solution." The Board has accepted this position. The ARPs are to be published in 1987 and will be available through the facilities of the Petroleum Industry Training Service (PITS).

Well licence applicants are expected to address each of the following items. However, the amount of detail provided should have regard for the type of well, the operational drilling complexity, and the risk and consequences of a blowout.

7.3.1 Drilling Plan - General

A drilling plan must be submitted which provides planning information and details respecting drilling-related equipment and procedures proposed, including but not limited to

(1) geological information including the extent and quality of offset data, a summary of nearby-well hole problems and adverse drilling occurrences, an assessment of the possibility of encountering similar problems and occurrences at the proposed well, and how the problems and occurrences will be dealt with;

(2) a description of the equipment that will be used to drill the well including

  (a) the blowout prevention (BOP) system, including a discussion as to whether or not blind shear rams will be used in place of the blind rams and, if not, an assessment or evaluation of the need for them;

  (b) drill pipe;

  (c) mud-gas separators;

(d) drilling fluid system and equipment (type, density, quantity, hole volume, surface volume, stockpile supplies and availability, H_2S scavenger, mixing and pumping equipment);

(e) wellhead (casing bowl, intermediate spool, valves) and casing (surface, intermediate, production);

(3) a description of the procedures that will be followed in drilling the well including

(a) inspection and testing procedures to ensure that all equipment is fully operational prior to the well reaching the critical depth and procedures to ensure that state of readiness is maintained;

(b) procedures to ensure that well-site personnel are familiar with the drilling and emergency procedures plan, are fully trained in the use of the drilling and safety equipment, and carry out regular drills in BOP and well control procedures;

(c) procedures to ensure wellbore and casing integrity (formation leak-off tests, casing pressure test, caliper logs);

(d) provisions for the taking of a directional survey prior to penetrating the critical zone, unless the applicant can satisfy the Board that it is not needed;

(4) a description of the monitoring of drilling and drilling fluid parameters that will be installed to ensure drilling occurrences (kicks, lost circulation) or warning signs (drilling rate, torque, pump pressure, gas-cut mud) are promptly detected;

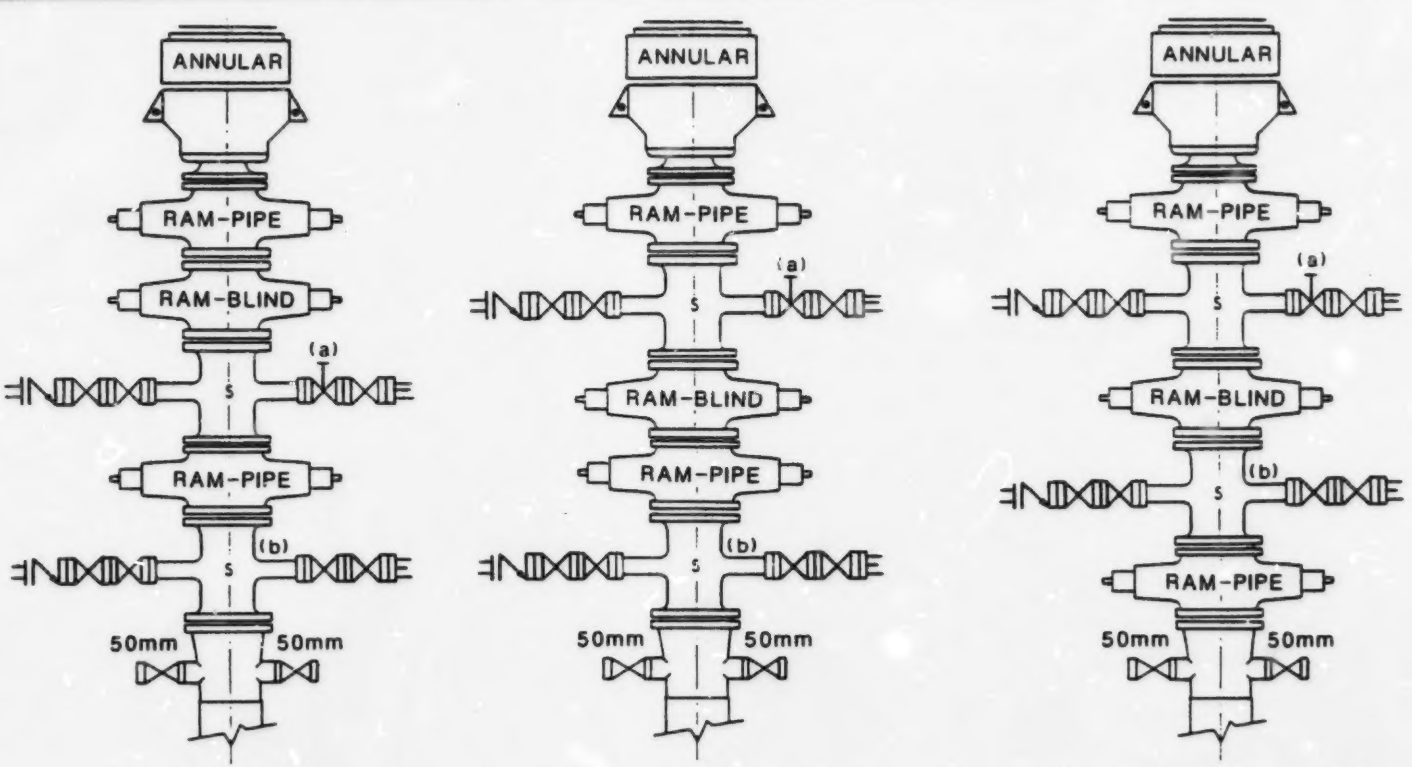
(5) information to confirm, prior to licensing, that sufficient well-site personnel will be available and they will be adequately trained and experienced for the drilling operation.

7.3.2 BOP Stack

(1) Minimum stack components shall consist of an annular preventer, two spools, and three rams except that for maximum projected depths less than 1800 m, flanged side outlets on the lower ram preventer may be substituted for the lower drilling spool. The configuration of the BOP stack shall conform to Figure 7-1.

(2) All pressure-containing components within the BOP stack, inclusive of attached valves and choke lines through to the outside valves of the choke manifold, with the potential to be exposed to H_2S gas shall be constructed of materials which meet the standards of the National Association of Corrosion Engineers Standard NACE MR-01-75.

(3) The BOP master control shall be installed at a location remote from the rig floor.


ANNULAR
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RAM-PIPE
50mm

ALTERNATIVE 1
PREFERRED

ALTERNATIVE 2[c]
PREFERRED

ALTERNATIVE 3[c]
SEE NOTE[d]

(a) The HCR valve mav be placed on either side of the gate valve.

(b) For wells projected to depths less than 1 800m flanged side outlets on the lower ram preventer may be substituted for the lower drilling spool.

(c) A ram blanking tool could be used when the drill string is out of the hole to allow the top ram to perform the function of a blind ram.

(d) For use only with sufficient surface or intermediate casing to contain maximum anticipated reservoir pressure.

Refer to Schedule 8 of the Oil and Gas Conservation Regulations for clarification regarding the symbols used.

FIGURE 7-1 ALTERNATIVE BOP STACK CONFIGURATIONS - CRITICAL SOUR WELLS

(4) Welded casing bowls shall be welded in accordance with an acceptable welding procedure developed from Appendix B of API Spec 6A, Specification for Wellhead and Christmas Tree Equipment, NACE MR-01-75, and Section IX of ASME, Boiler and Pressure Vessel Code.

(5) Threaded casing bowls shall be manufactured in accordance with API Spec 6A, the make-up procedures and torque in accordance with API RP 5C1, Care and Use of Casing and Tubing, and the thread compound used in accordance with API Bul 5A2, Bulletin on Thread Compounds.

(6) Drilling components installed between the top flange of the uppermost blowout preventer and the bottom of the rig floor shall be constructed to permit their removal while drill pipe or other equipment is in the hole.

7.3.3 Rig Inspections

(1) A weekly detailed rig inspection shall be performed by the operator and contractor. An inspection check sheet shall be used and retained.

(2) A detailed inspection and blowout prevention drill shall be conducted

   (a) prior to drilling out the surface casing,
   (b) prior to drilling out the intermediate casing, and
   (c) within the 24-hour period prior to penetrating the critical zone.

The Board field office must be notified at least 48 hours prior to these inspections and drills being initiated, so that staff may witness these activities.

7.3.4 Kick Detection

(1) Each rig shall have installed and operate an automated mud tank volume monitoring system that meets the following specifications:

   (a) The system will be designed and installed so that it is capable of detecting a gain or loss of 1.0 m^3 in total drilling fluid volume. In general this will require a probe in each active compartment.

   (b) A fluid volume monitoring station with an alarm must be located at or near and be visible to the driller's position. The monitor must be equipped with a recording chart.

   (c) The monitoring station must have a large bright flashing indicator light which will come on automatically whenever the alarm is shut off.

(d) When drilling, the alarm must be set to detect a gain or loss in total drilling fluid volume of not more than 2.0 m^3.

(2) Each driller must have an adequate understanding of the proper operation of all kick detection and monitoring equipment.

(3) Indicators must be in operation for measuring the hook load, pump pressure, the pump strokes per minute, and table torque. All such indicators must be visible from the driller's position.

(4) A continuous recording device is required to record rate of penetration, pump pressure, pump strokes per minute, hook load, rotary table revolutions per minute (rpm), and rotary torque. This record must be kept for the entire well and be made available for inspection at the well site until rig release.

(5) A trip tank is required which must meet the following criteria:

(a) The trip tank design must be such that a change in level of 25 millimetres (mm) equals a volume change of not more than 0.075 m^3. This equates to a maximum surface area of 3.0 m^2. A minimum usable trip tank volume of 3.0 m^3 is recommended.

(b) The hole fill volume must be measured either by manual gauging of the trip tank or by reading a mechanical or automated system visible at the driller's position. If a mechanical monitoring system is in use, the volume increments on the monitoring board must be 0.1 m^3. If an electronic probe is used, the monitor's measurement increments must not exceed 0.0375 m^3 and the monitor must have a readout to two (2) decimal places.

(c) The hole must be filled to surface after every 15 singles (maximum) of drill pipe and after every 3 singles (maximum) of drill collars are pulled.

(d) A trip record is required for every trip. During the critical period it shall be signed and dated by the operator's well site supervisor and the contractor's rig manager and maintained at the well site until rig release.

(e) Each trip record must show the actual volume used each time the hole is filled as specified above. The cumulative total fill volume must also be recorded after each successive fill. On the same page the record must also show the theoretical volume required at each fill point, plus the theoretical cumulative fill volumes.

(f) Minimum 5-minute flow checks are required at each of the following stages: prior to beginning a trip out of the hole; after pulling the first 15 singles of drill pipe from the hole;

prior to pulling the first stand of drill collars from the hole; and after all the drill string is out of the hole.

7.3.5 Monitoring for H_2S Contamination of the Drilling Fluid

If a water-based drilling fluid is in use, a check and record of the sulphide content in the mud must be maintained throughout the critical period. In addition, a continuous pH monitoring system must be located as close as possible to the flowline discharge of the drilling rig. The monitoring unit is to be equipped with an alarm which will indicate a drop in pH.

7.3.6 Ambient H_2S Detection

(1) Each drilling rig must have a continuous H_2S detection monitoring system that activates audible and visual alarms near the driller's position when sensing ambient air H_2S concentrations of 10 parts per million (ppm) or greater. The system must consist of at least one sensor located at the shale shaker. Additional sensors may be placed at other locations such as the bell nipple, rig floor, and mud mixing unit. Sensors must be able to detect H_2S concentrations of 5 ppm and greater. Qualified personnel should be on site to function test and provide maintenance to this instrumentation.

(2) At least one working portable ambient H_2S concentration detection device shall be on location.

7.3.7 Drill Pipe

Specific requirements for drill pipe are being reviewed by the BPRC. In the interim, drill pipe proposed for use at critical wells must meet the following criteria:

(1) Used drill pipe must be inspected in accordance with Section 10 of API RP 7G, Drill Stem Test Design and Operating Limits. The inspection personnel's qualifications, equipment and procedures must be in accordance with API RP 5A5, Field Inspection of New Casing, Tubing and Plain-End Drill Pipe.

(2) New and used drill pipe must be hardness tested, and abnormally hard joints must be removed from the drill-string in use.

(3) Only premium or better class drill pipe (API RP 7G) shall be used at critical sour wells.

7.3.8 BOP Manifold

The BOP manifold configuration shall be as illustrated in Figure 7-2.

(1) The manifold and piping shall provide complete redundancy from the BOP stack, through the manifold, to the mud-gas separators, and finally to the flare pit.

(2) Where the ERCB has approved only one mud-gas separator, redundancy from the manifold to the single mud-gas separator, and from the mud-gas separator to the flare pit is not required.

(3) A separate bleed-off line from each spool to a separate manifold wing (side) is required. A separate casing pressure gauge for each manifold wing is required.

(4) A remote hydraulic operated non-rubber sleeve choke is required on the primary manifold wing (upper BOP spool) and a manual operated choke is required on the secondary manifold wing (lower BOP spool).

(5) BOP manifolds shall be filled with suitable water soluble non-freezing fluids and adequately heated during the winter season.

7.3.9 Mud-Gas Separators

(1) Two mud-gas separation devices are required for the drilling of critical sour wells.

(2) Notwithstanding (1), upon application the Board may approve the use of a single mud-gas separation device for the drilling of critical sour wells providing

   (a) the maximum potential H_2S release rate (section 4.2) has been estimated at less than 2.0 m^3/s;

   (b) the geological prognosis of the proposed well is well established on the basis of offset wells;

   (c) normal formation pressures are expected;

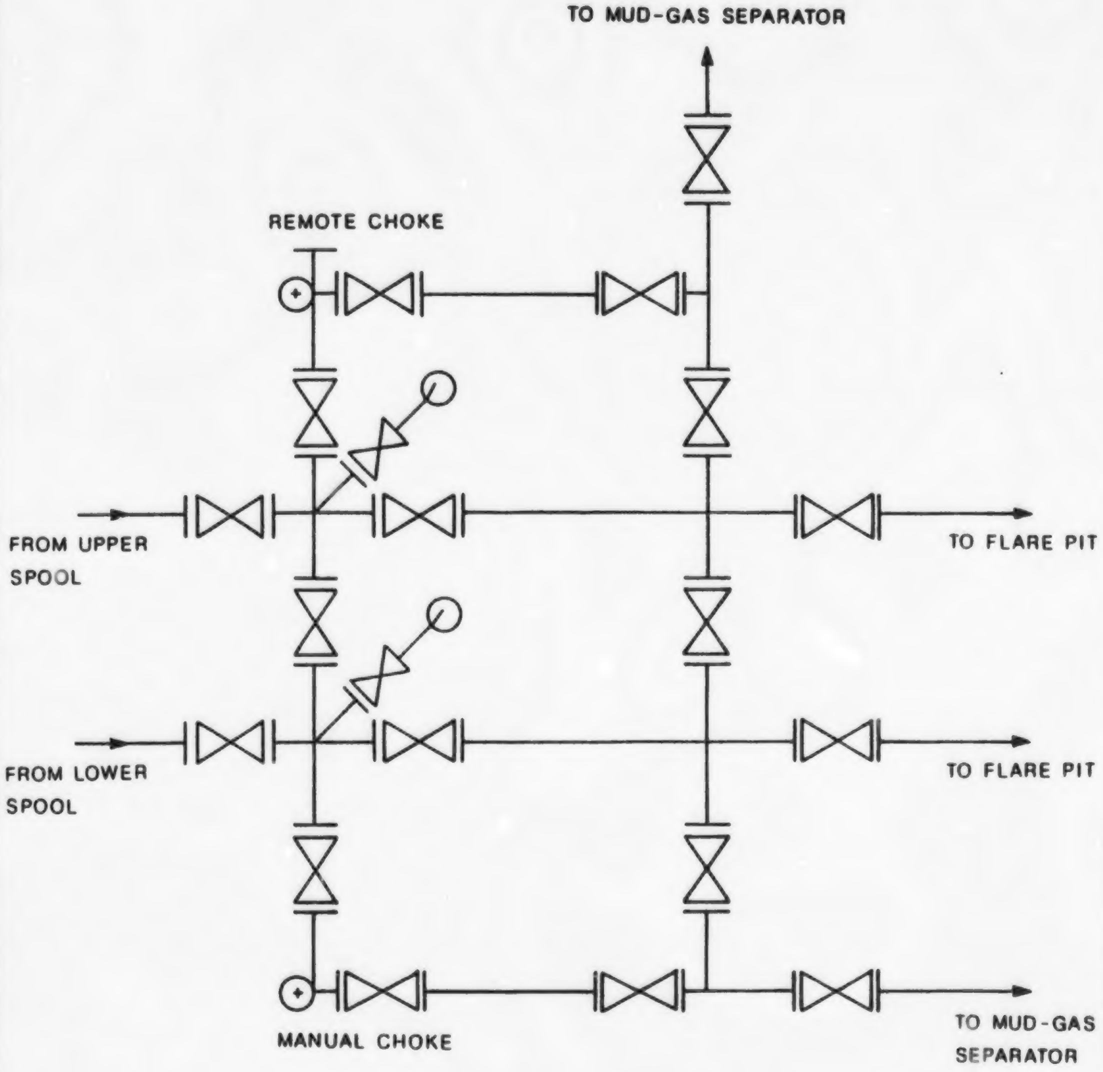
   (d) no significant lost circulation is expected; and

   (e) the consequences of a blowout are considered minimal.

(3) The primary device must be an atmospheric, open bottom, mud-gas separator and must conform to the specifications detailed in Table 7-1. The secondary device may be an enclosed mud-gas separator.

(4) All materials used in vessels, inlet lines, and vent lines for mud-gas separators must be suitable for sour service and have a maximum yield strength not exceeding 550 megapascals.

Suitable materials are as follows:


TO MUD-GAS SEPARATOR
REMOTE CHOKE
FROM UPPER SPOOL
TO FLARE PIT
FROM LOWER SPOOL
TO FLARE PIT
MANUAL CHOKE
TO MUD-GAS SEPARATOR

Refer to Schedule 8 of the Oil and Gas Conservation Regulations for clarification regarding the symbols used. Note that only one valve is required immediately downstream of the chokes

FIGURE 7-2 MANIFOLD LAYOUT - CRITICAL SOUR WELLS

TABLE 7-1 ATMOSPHERIC, OPEN-BOTTOM, MUD-GAS SEPARATOR VESSEL AND VENT LINE DIAMETER REQUIREMENTS FOR CRITICAL SOUR WELL DRILLING

Drilling Depth (m) Less Than	*Minimun Vessel Diameter (mm)	Minimum Vent Line Diameter (mm)	
		with 1 m of Fluid Head	with 2 m of Fluid Head
750	355.6	101.6	101.6
1 800	609.6	152.4	127.0
2 700	660.4	172.9	152.4
3 600	762.0	203.2	152.4
5 000	914.4	254.0	203.2

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* Vessel diameter was determined using a vapour load constant (k) of 0.11 m/s.

- Regular Materials

Plate:	ASTM A516	Grade 65
	ASTM A516	Grade 70
Pipe:	ASTM A106	Grade B
	ASTM A53	Grade B
	API 5L	Grade B
	API 5L	Grade X42
	CSA Z245.1	Grade 241 Category I
	API H40, J55, K55 seamless casing (if hardness tested)	

- Low-temperature Tough Materials

Plate:	ASTM A516	Grade 65 c/w Supplementary 5
	ASTM A516	Grade 70 c/w Supplementary 5
Pipe:	ASTM A333	Grade 6
	CSA Z245.1	Grade 241 Category II

(5) Mud-gas separator vent lines shall slope down towards the flare pit.

7.3.10 Drill String Valves

(1) Lower kelly cocks and stabbing valves must be certified by the manufacturer as being able to be routinely opened with 7000 kilopascals (kPa) pressure below the valve.

(2) Lower kelly cocks must be installed.

7.3.11 Intermediate Casing

(1) Intermediate casing shall be set to an appropriate point above the zone from which the sour gas or oil is expected.

(2) Notwithstanding (1), upon application the Board may waive the requirements for intermediate casing providing

(a) the geological prognosis of the proposed well is well established and it offsets existing development,

(b) no significant lost circulation is expected,

(c) normal formation pressures are expected, and

(d) the wellbore (surface casing and open hole section) integrity will be evaluated prior to penetrating the critical zone and found satisfactory.

7.3.12 Personnel

Supervision

(1) On-site supervisors must have a current PITS Second Line Supervisor BOP Well Control certificate, H_2S Awareness Training, and experience in drilling sour wells.

(2) During the critical period of the drilling operation, sufficient supervision must be on site and available so that no individual supervisor is required to work a shift longer than 12 hours.

Rig Crew

(3) On-site rig managers must have a current PITS Second Line Supervisor BOP Well Control certificate, and drillers must have a current PITS First Line Supervisor BOP Well Control certificate.

(4) On-site rig managers and drillers must have H_2S Awareness Training, and experience in drilling sour wells.

(5) A minimum 5-man drilling crew shall be maintained and all crew members shall be trained in H_2S safety.

Service Personnel

(6) Key on-site service personnel including mud-men, loggers, geologists, etc, shall have previous experience in sour well drilling operations.

(7) All well-site personnel shall be trained in H_2S safety.

Safety Specialists and Equipment

During the critical period of the drilling operation safety personnel and adequate safety equipment for all workers must be on site (minimum requirements are specified by the OH&S Act and regulations thereunder).

APPENDIX 1 DEFINITIONS

For the purpose of this directive:

(1) Completion/Servicing Stage: includes all operations which are continuously attended subsequent to the drilling stage, and which are necessary to prepare the well to produce, or after a period of production, to restore the well or to repair the well.

(2) Critical Sour Well: A designation that reflects the proposed well's proximity to an urban centre and its maximum potential hydrogen sulphide (H_2S) release rate during the drilling stage. The casing flow or open-hole flow configuration is assumed in arriving at this designation. Included are:

(a) any well from which the maximum potential H_2S release rate is 0.01 cubic metres per second (m^3/s) or greater and less than 0.1 m^3/s and which is located within 500 metres (m) of the corporate boundaries of an urban centre, or

(b) any well from which the maximum potential H_2S release rate is 0.1 m^3/s or greater and less than 0.3 m^3/s and which is located within 1.5 kilometres (km) of the corporate boundaries of an urban centre, or

(c) any well from which the maximum potential H_2S release rate is 0.3 m^3/s or greater and less than 2.0 m^3/s and which is located within 5 km of the corporate boundaries of an urban centre, or

(d) any well from which the maximum potential H_2S release rate is 2.0 m^3/s or greater, or

(e) any other well which the Board classifies as a critical sour well having regard to the maximum potential H_2S release rate, the population density, the environment, the sensitivity of the area where the well would be located, and the expected complexities during the drilling phase.

(3) Critical Period: any time or depth starting with some reasonable period prior to when a well has penetrated or may have penetrated any formation (or combination of formations) that may be capable of flowing H_2S at critical sour well rates, and continues until such formations have been rendered incapable of flowing into the wellbore by running and cementing casing, or by cement abandonment plug, or approval has been given by the Board to reclassify the well or formation as no longer critical.

(4) Drilling Stage: includes all operations which are continuously attended, from spudding-in until production casing is cemented or the well is abandoned.

(5) Emergency Planning Zone: an area surrounding a well where residents or other members of the public would be at risk in the event of an uncontrolled release of H_2S. Its size is generally determined using Figures 6-1 or 6-1a as guidelines.

(6) Flow Configuration: the well equipment and flow configurations to be considered in determining H_2S release rate at various stages of a well's drilling or producing life. These are

(a) casing flow or open-hole flow where reservoir fluids are free to flow up the casing or open hole without any other tubular goods in the wellbore,

(b) tubing and annular flow where reservoir fluids flow up the tubing and the annular space between the tubular string and the casing or open hole, and

(c) tubing flow where flow is only up the tubing.

(7) Level Classification: a designation to stipulate separation distances of sour wells for land-use and public safety purposes. The level classification for sour wells is determined by assessing the maximum potential surface H_2S deliverability that can be attained against zero back pressure during the suspended/producing stage of a well. A well may be completed with a packer and capable of flowing through tubing only, or completed without a packer and capable of flowing through tubing and also up the annulus. The appropriate flow configuration must be considered in arriving at the level classification.

(8) Potential H_2S Release Rate: the calculated H_2S deliverability that can be attained at surface against zero back pressure with various flow configurations, expressed using the unit of m^3/s at standard pressure and temperature conditions.

(9) Public Facility: a recreational area such as a campground, or a public building such as a rural school or hospital, situated outside of an urban centre; and for the purpose of this directive includes any similar development the Board may designate as a public facility.

(10) Separation Distance: the required distance between a sour well and developments such as individual permanent dwellings, unrestricted country development, public facilities, and the corporate boundaries of urban centres.

(11) Sour gas: natural gas, including solution gas containing hydrogen sulphide (H_2S).

(12) Sour Well: any oil or gas well expected to encounter sour gas-bearing formations during drilling or any oil or gas well capable of producing sour gas.

(13) Surface Improvement: means a railway, pipeline or other right of way, road allowance, surveyed roadway, dwelling, industrial plant, aircraft runway or taxiway, building used for military purposes, permanent farm buildings, school, or church.

(14) Suspended/Producing Stage: includes all operations which are not continuously attended, at wells that may or may not be capable of producing.

(15) Unrestricted Country Development: any collection of permanent dwellings situated outside of an urban centre and having more than eight permanent dwellings per quarter section; and for the purpose of this directive includes any similar development the Board may designate as an unrestricted country development.

(16) Urban Centre: a city, town, new town, village, summer village, or other incorporated centre, and for the purpose of this directive includes any similar development the Board may designate as an urban centre.

APPENDIX 2 REFERENCES

(1) Draft Interim Directive ID 84-

BLOWOUT PREVENTION AT SOUR WELLS issued on 27 April 1984 as Appendix 5 of the report, Lodgepole Blowout Inquiry - Phase 2, Decision D 84-5.

(2) Interim Directive ID 81-3

MINIMUM DISTANCE REQUIREMENTS SEPARATING NEW SOUR GAS FACILITIES FROM RESIDENTIAL AND OTHER DEVELOPMENTS issued on 16 December 1981.

(3) Interim Directive ID-OG 76-2

✓ EMERGENCY PROCEDURE PLANS FOR SOUR GAS FACILITIES issued on 14 October 1976.

(4) Decision D 84-9

LODGEPOLE BLOWOUT INQUIRY PANEL DECISION REPORT, December 1984, ERCB Calgary.

(5) Decision D 84-5

LODGEPOLE BLOWOUT INQUIRY PHASE 2 DECISION REPORT, April 1984, ERCB Calgary.

(6) NACE, Sulfide Stress Cracking Resistant Metallic Materials for Oilfield Equipment, 1984 Editorial Revision MR-01-75, Houston, Texas.

(7) API, Specification for Wellhead and Christmas Tree Equipment, Fifteenth Edition, April 1986. Spec 6A, Dallas, Texas.

(8) ASME, Boiler and Pressure Vessel Code, Qualification Standard for Welding and Brazing Procedures, 1983 Section IX, New York, New York.

(9) API, Recommended Practice for Care and Use of Casing and Tubing, Fourteenth Edition, May 1986 RP 5C1, Dallas, Texas.

(10) API, Bulletin on Thread Compounds, Fifth Edition, April 1972 Bul 5A2, Dallas, Texas.

(11) API, Recommended Practice for Drill Stem Design and Operating Limits, Eleventh Edition, May 1984 RP 7G, Dallas, Texas.

(12) API, Recommended Practice for Field Inspection of New Casing, Tubing, and Plain End Drill Pipe, Second Edition, May 1986 API RP 5AR, Dallas, Texas.

(13) ASTM, American Society for Testing and Materials, 1986 Edition, Philadelphia, Pennsylvania.

(14) API, Specification for Line Pipe, Thirty-Fifth Edition, May 1985 API Spec 5L, Dallas, Texas.

(15) CSA, Canadian Standards Association Steel Line Pipe, Second Edition, March 1986, CAN3 - Z245.1 - M86, Toronto, Ontario.

(16) API, Specification for Casing, Tubing, and Drill Pipe, Thirty-Eighth Edition, May 1985 API Spec 5A, Dallas, Texas.

ENERGY RESOURCES CONSERVATION BOARD
Calgary Alberta

Interim Directive
ID 81-3

TO: ALL WELL, PIPELINE AND GAS PLANT OPERATORS

MINIMUM DISTANCE REQUIREMENTS SEPARATING NEW SOUR GAS FACILITIES FROM RESIDENTIAL AND OTHER DEVELOPMENTS

This directive replaces Interim Directive ID 79-2 issued 22 February 1979. Appendices 1 and 2 are identical to those in ID 79-2 with the exception that the "Applications" section of Appendix 1 has been deleted. A new Appendix 3 sets out requirements for applications for well licences and pipeline permits and includes a section dealing with concurrent applications for these facilities.

The separation distances described in this directive were developed by Alberta Environment and the Board and have been applied since early 1979 in granting approvals for sour gas facilities near areas of public use. These distances increase as the potential sour gas release volumes increase and with increasing population density.

With regard to encroachment of occupied buildings on existing sour gas facilities, the Subdivision Regulations of The Planning Act, 1977, were amended by Order in Council 382/79 to require setbacks similar to the Board's separation distances.

Interim Directive ID 79-2 is hereby rescinded.

ISSUED at Calgary, Alberta, on 16 December 1981.

ENERGY RESOURCES CONSERVATION BOARD

V. E. Bohme
Board Member

APPENDIX 1 TO ID 81-3 MINIMUM DISTANCE REQUIREMENTS SEPARATING NEW SOUR GAS FACILITIES FROM RESIDENTIAL AND OTHER DEVELOPMENTS

Definitions:

For the purpose of this Directive:

(1) sour gas is natural gas having an H_2S content of 10 moles per kilomole or greater, or such lesser or greater H_2S content that the Board may stipulate in a particular case;

(2) a sour gas facility is any facility which produces, processes, or transports sour gas including:

- a) gas wells producing or capable of producing sour gas,
- b) gas lines or secondary lines that transport sour gas,
- c) gas plants, and
- d) any other installations that the Board may designate;

(3) unrestricted country development is defined as any collection of permanent dwellings situated out of urban centres and having more than eight permanent dwellings per quarter section; and for the purpose of this Directive includes any similar development the Board may designate as an unrestricted country development;

(4) a public facility is defined as a recreational area such as a campground, or a public building such as a rural school or hospital, situated out of urban centres; and for the purpose of this Directive includes any similar development the Board may designate as a public facility;

(5) an urban centre is defined as a city, town, village, or other incorporated centre, and for the purpose of this Directive includes any similar development the Board may designate as an urban centre;

(6) separation distance is the required distance between a sour gas facility and developments such as individual permanent dwellings, unrestricted country development, public facilities, and urban centres;

(7) the calculated flow rate of potential H_2S release from a sour gas well shall be established using the maximum wellhead deliverability that can be attained at any time through the tubing against zero wellhead pressure, and shall be expressed in the unit m^3/s at standard conditions;

(8) the calculated volume of potential H_2S release from a sour gas facility, other than a sour gas well, shall be established using the maximum operating pressure, shall be expressed in the unit m^3 at standard conditions, and for the purposes of this calculation shall assume that any automatic block valves close instantaneously upon failure of the facility.

Policy:

For the purpose of the policy, sour gas facilities shall be grouped into levels in accordance with their capability to release sour gas.

(1) A level 1 facility is a sour gas well with a potential H_2S release rate of 0.3 m^3/s or less, or any other sour gas facility with a potential to release 300 m^3 of H_2S or less. A new Level 1 facility, other than a sour gas well shall have no separation distance requirement other than that associated with the easement for the right of way. All wells remain subject to Section 2.110 of the Oil and Gas Conservation Regulations which requires a separation distance of 0.1 km. Notwithstanding this clause, the Board may specify some other separation distance for a Level 1 facility should the circumstances warrant such action.

(2) A Level 2 facility is a sour gas well with a potential H_2S release rate of more than 0.3 m^3/s and less than 2.0 m^3/s, or any other sour gas facility with a potential to release more than 300 m^3 and less than 2000 m^3 of H_2S. A new Level 2 facility shall be situated to provide 0.1 km separation distance between it and any permanent dwelling, and 0.5 km separation distance between it and any urban centre or public facility.

(3) A Level 3 facility is a sour gas well with a potential H_2S release rate of more than 2.0 m^3/s and less than 6.0 m^3/s, or any other sour gas facility with a potential to release more than 2000 m^3 and less than 6000 m^3 of H_2S. A new Level 3 facility shall be situated to provide 0.1 km separation distance between it and any permanent dwelling, 0.5 km separation distance between it and any unrestricted country development, and 1.5 km separation distance between it and any urban centre or public facility.

(4) A Level 4 facility is a sour gas well with a potential H_2S release rate of more than 6.0 m^3/s, or any other sour gas facility with a potential to release more than 6000 m^3 of H_2S. A new Level 4 facility shall be so situated that as a minimum, it shall meet the requirements set out for a Level 3 facility. However, the Board may require greater separation distances or set out other such requirements it deems necessary.

(5) For ease of reference a summary of the foregoing policy is presented in Appendix 2.

(6) The Board recognizes that notwithstanding the level into which an application for a sour gas facility may fall, under some special circumstances a detailed review may indicate that another H_2S release level is more applicable.

APPENDIX 2 TO ID 81-3 SUMMARY OF MINIMUM DISTANCE REQUIREMENTS SEPARATING NEW SOUR GAS FACILITIES FROM RESIDENTIAL AND OTHER DEVELOPMENTS

	Potential H_2S Releases		
Level of Sour Gas Facility	Sour Gas Well Release Rate m^3/s	Other Sour Gas Facility Release Volume m^3	Minimum Distance to Various Developments
1	<0.3	<300	- Minimum distance for wells 0.1 km as stated in Section 2.110 of the Oil and Gas Conservation Regulations. - No minimum distance for other sour gas facilities except that associated with easement for right of way, unless otherwise specified by the Board.
2	0.3 - 2.0	300 - 2000	- 0.1 km to individual permanent dwellings and unrestricted country development. - 0.5 km to urban centre or public facility.
3	2.0 - 6.0	2000 - 6000	- 0.1 km to individual permanent dwellings up to 8 dwellings per quarter section. - 0.5 km to an unrestricted country development. - 1.5 km to an urban centre or public facility.
4	>6.0	>6000	- As specified by the Board, but not less than Level 3.

ENERGY RESOURCES CONSERVATION BOARD
Calgary Alberta

Interim Directive
ID 81-4

TO: ALL WELL AND PIPELINE OPERATORS

PROPOSED WELLS AND PIPELINES NEAR URBAN CENTRES

Concern has been expressed by municipal administrations and planning authorities regarding new wells or pipelines near urban centres. In some cases these centres are expanding, and the direction of growth is limited by wells and pipelines, in addition to topography, existing surface improvements or serviceability.

To ensure that municipal administrators are made aware of wells or pipelines proposed near cities, towns or villages, the applicant for a well licence or a pipeline permit shall henceforth include in its application one of the following:

1. A statement, where appropriate, on the plan of application or elsewhere, that the well or pipeline is more than 1.5 km from the corporate limits of any city, town or village.

2. Where the proposed well or pipeline is within 1.5 km of the corporate limits of a city, town or village, a statement that

   (a) the applicant has advised the municipal administration of its intent to apply for a licence to drill a well, or a permit to construct a pipeline, and

   (b) the municipality does or does not have any objections to the application.

The terms of reference of this Interim Directive do not include gas distribution lines that will operate at 700 kPa or less. In addition, licence and permit applications for wells and pipelines likely to produce or transport gas having a hydrogen sulphide content of greater than 10 moles per kilomole are dealt with in Interim Directive ID 81-3.

ISSUED at Calgary, Alberta, on 16 December 1981.

ENERGY RESOURCES CONSERVATION BOARD

V E Bohme
V. E. Bohme
Board Member

APPENDIX 3

Subdivision Regulation, Schedule 6

"SCHEDULE 6

MINIMUM SEPARATION DISTANCES FROM SOUR GAS FACILITIES

1. In this Schedule,

   (a) "Board" means the Energy Resources Conservation Board;

   (b) "existing or probable development" has the meaning given to it by section 11.1(4);

   (c) "potential release rate", with reference to a sour gas facility consisting of a well, means the estimated rate of flow of hydrogen sulphide from the well, expressed in cubic metres of hydrogen sulphide per second at standard conditions, assuming a failure of or damage to the well that in turn resulted in zero wellhead pressure;

   (d) "potential volume release", with reference to a sour gas facility other than a well, means the estimated volumes of hydrogen sulphide, expressed in cubic metres at standard conditions, that would be released to the atmosphere in event of a failure of the facility or damage to the facility assuming that

      (i) the facility is being operated at its maximum operating pressure at the time of the failure or damage, and

      (ii) any automatic block valves in the facility close instantaneously upon the failure or the damage;

   (e) "rural public facility" means

      (i) an area of land or a building used for recreational purposes, or

(ii) a school, hospital or other public building and the land used in connection with it,

(f) "standard conditions" means the standard pressure and temperature conditions prescribed by the regulations under The Oil and Gas Conservation Act for the metering and measurement of gas;

(g) "unrestricted country development" means any area outside an urban municipality containing permanent dwellings and having a density of more than 8 dwellings per quarter section;

(h) "urban municipality" means

(i) a city, town, new town, village or summer village, or

(ii) a hamlet (as defined in The Municipal Government Act) having a population of at least 75 persons.

2. For the purposes of this Schedule, sour gas facilities are classified as follows:

(a) a "Level 1 facility" is

(i) a well having potential release rate of 0.3 cubic metres of hydrogen sulphide per second or less, or

(ii) a sour gas facility, other than a well, having a potential volume release of 300 cubic metres of hydrogen sulphide or less;

(b) a "Level 2 facility" is

(i) a well having a potential release rate of more than 0.3, but not more than 2, cubic metres of hydrogen sulphide per second, or

(ii) a sour gas facility, other than a well, having a potential volume release of more than 300, but not more than 2000, cubic metres of hydrogen sulphide;

(c) a "Level 3 facility" is

(i) a well having a potential release rate of more than 2, but not more than 6, cubic metres of hydrogen sulphide per second, or

(ii) a sour gas facility, other than a well, having a potential volume release of more than 2000, but not more than 6000, cubic metres of hydrogen sulphide;

(d) a "Level 4 facility" is

(i) a well having a potential release rate of more than 6 cubic metres of hydrogen sulphide per second, or

(ii) a sour gas facility, other than a well, having a potential volume release of more than 6000 cubic metres of hydrogen sulphide.

3. The following are the minimum separation distances between the location of any existing or probable development and a sour gas facility classified in accordance with section 2 of this Schedule:

(a) in the case of a Level 1 facility consisting of a well, the minimum separation distance is 0.1 kilometre;

(b) in the case of a Level 1 facility consisting of a pipeline, the minimum separation distance is the distance between the pipeline and the boundary of the right-of-way for the pipeline;

(c) in the case of a Level 1 facility that is not a well or a pipeline, the minimum separation distance is the distance between the facility and the boundary of the site for the facility;

(d) in the case of a Level 2 facility, the minimum separation distance is

(i) 0.1 kilometres, if the existing or probable development is a permanent dwelling, or

(ii) 0.5 kilometres, if the existing or probable development is within an urban municipality or is a rural public facility;

(e) in the case of a Level 3 facility or Level 4 facility, the minimum separation distance is

(i) 0.1 kilometres, if the existing or probable development is a permanent dwelling,

(ii) 0.5 kilometres, if the existing or probable development is within an unrestricted country development, or

(iii) 1.5 kilometres, if the existing or probable development is within an urban municipality or is a rural public facility.

4. Section 3 of this Schedule does not apply to a case where the proposed subdivision is being made for the purpose of providing a site for a sour gas facility."

In addition to the separation distances established, the ERCB, in Interim Directive ID 81-4, requires that an applicant for a well licence or pipeline permit include in the application one of the following:

1. A statement, where appropriate, on the plan of application or elsewhere, that the well or pipeline is more than 1.5 km from the corporate limits of any city, town or village.

2. Where the proposed well or pipeline is within 1.5 km of the corporate limits of a city, town or village, a statement that

   (a) the applicant has advised the municipal administration of its intent to apply for a licence to drill a well, or a permit to construct a pipeline, and

   (b) the municipality does or does not have any objections to the application.

This is to ensure that municipal administrators are made aware of wells or pipelines proposed near cities, towns or villages.

APPENDIX 4

Factsheet No. 3
Energy Resources Conservation Board Enerfax Publication Series

ENERFAX
Information on the Development of Alberta's Energy Resources

FACTSHEET NO. 3:

INSPECTION AND ENFORCEMENT IN ENERGY DEVELOPMENT IN ALBERTA

The Energy Resources Conservation Board (ERCB) was established by the Alberta Government to be responsible for regulating the safe and efficient development of energy resources in Alberta. These resources include coal, hydro and thermal electricity, natural gas, conventional oil and oil sands, and the necessary pipelines and electric transmission lines needed to move the resources to distributors.

The ERCB ensures the safe and efficient development of Alberta's energy resources by

1) setting the standards and specifications for location, equipment and procedures for energy development projects through regulations and conditions included with project approvals;

2) inspecting operating sites and enforcing the standards, specifications and conditions of approval.

These responsibilities are shared with several Alberta government departments; for example, Alberta Environment and Occupational Health & Safety. Each department sets the standards within its own jurisdiction.

All new energy developments require approval from the ERCB before any construction can commence. Nearly 13,000 energy-related applications were handled by the ERCB in 1984. Ninety per cent of these were for oil or gas wells, or to construct or operate pipelines. Most of these applications were routine and approval was straightforward after careful examination by the ERCB. However, before approval is given, the more complex applications are frequently referred to government departments such as Alberta Environment, as well as by the ERCB. A public hearing may be held by the ERCB if there are objections to a proposal. A total of 68 public hearings were held by the ERCB in 1984.

After approval (if the application is approved) and from time to time, each project site will be inspected by the ERCB to make certain the operator is meeting the prescribed conditions and standards.

Who makes inspections?

The ERCB and several government departments. These include

Alberta Environment, enforcing clean air and clean water regulations;

Energy & Natural Resources, safeguarding Alberta's fish, wildlife, forests and public lands;

Alberta Labour, inspecting pressure vessels such as boilers and steaming equipment, gas distribution pipelines within incorporated towns, and electrical installations.

Occupational Health & Safety (part of the Department of Workers' Health, Safety & Compensation), ensuring safe working conditions at work sites;

Alberta Culture, inspecting operations that may affect historical, archeological or palaeontological sites;

Utilities & Telecommunications, inspecting low-pressure natural gas distribution pipelines operating outside small towns (unincorporated areas).

Who makes sure promises made at ERCB public hearings are met?	The enforcement of commitments made by companies at public hearings has recently been strengthened by the ERCB. After each public hearing, a list of company commitments is made by the ERCB, which then ensures that the proper government department follows up. When necessary, the ERCB takes action to force a company to fulfil any promises within ERCB's jurisdiction.
What does the ERCB inspect?	Inspections are made of all oil, gas, coal and pipeline facilities. These inspections include well drilling and servicing, oil production, gas production (including sweet and sour gas plants), environment (including noise, odour, smoke and spills) and pipelines.
How many ERCB inspectors are there?	There are more than 100 ERCB field inspectors, with an additional 20 support staff.
Are they all in Calgary?	No! Most of them are located in field offices close to major areas of energy development. The ERCB has nine field offices throughout the province, each with a complement of field inspectors.

How many inspections are made in a year?	The ERCB, alone, makes more than 25,000 inspections of oil and gas operations every year.
How often do the ERCB inspectors make these checks?	Inspections are made at selected stages of energy development, depending on the type of project and the previous inspection history of that facility, although not every facility is checked at every stage. In addition, the ERCB responds to all complaints and reports from the public and this often involves extra inspections. Routine inspections include * inspection of the drilling rigs on approximately one-third of the wells drilled in the province; * spot checks during the construction and testing of pipelines; * inspections of oil and gas batteries (wells and equipment for collecting, separating and measuring oil and gas) to make sure equipment is the type specified and that it is in the correct location and being used according to regulations and conditions set out when the facility was approved; * checking that production records are accurate and properly completed; * inspection of natural gas processing plants, particularly sour gas facilities; * inspections to ensure the clean-up of oil and salt water spills and reclamation of affected areas;

* environmental inspections to ensure procedures and equipment are in place to minimize environmental impacts. Included in these inspections are responses to reports and complaints from the public;

* investigating fires, accidents and equipment failures to determine the causes and to order necessary changes to avoid similar incidents happening again.

How detailed are these inspections?	The inspectors check to ensure that all requirements are met. For example, inspection of a drilling rig can take from 3 to 4 hours, and complete inspection of an oil production battery may take 2 to 3 days.
How strict are these inspections?	Strict! The use of improper equipment or failure to meet stated requirements could lead to suspension of operations. Even the absence of a minor piece of safety equipment on a drilling rig is enough to make the inspection "unsatisfactory". Inspections resulting from a complaint may not immediately reveal the problem, and several inspections may have to be carried out before a complaint can be traced back to the problem.
What happens when a site is "unsatisfactory"?	The operator is told to correct the problems within a given period of time. However, any facility can be shut down immediately if the situation appears to be dangerous. In most cases, the ERCB or a government department states that changes are to be made within a specified time, and

the operator carries out the work. The work is then checked. Frequent, flagrant or particularly serious violations may lead to prosecution.

What happens if problems are not corrected?	When an operator is unable or unwilling to correct a problem within a specified period of time, the ERCB can shut down the facility. Inevitably, there may be delays in obtaining the necessary equipment to correct a problem, but if the situation is dangerous, the facility will be shut down immediately by the ERCB. Sometimes the operator may be given a short time extension in which to make sure the problem is corrected, provided the ERCB is satisfied the operator is making all reasonable efforts to meet requirements and safety is not a concern.
Whom do I call with questions or complaints about a specific site?	If you know the name of the company, call their local office and give them a chance to rectify the situation. If not satisfied, call the ERCB's local office. The ERCB responds to all complaints, but may not necessarily have to visit the site. They will contact the company, get an explanation, order whatever action is necessary, and report back to you.
What if I don't know the name of the company?	Call the ERCB's local office, explain the problem and location and let them make inquiries. In 1984, the ERCB's local offices handled more than 500 complaints and at least 4 times that number of inquiries.
Should I contact government departments myself?	Yes, if you know who is responsible for particular concerns, such as Alberta Environment. If not, call the ERCB local office and they will either refer the matter to

the correct department, or give you the name and telephone number of the correct department to contact.

Additional reading:

This factsheet is one of a series. You may find the others in the series useful.

No. 1 What Is The Energy Resources Conservation Board?
No. 2 Having Your Say At An ERCB Public Hearing
No. 4 Finding Out! -- Publications From The ERCB
No. 5 The Lindbergh Oil Sands Area

For more information or additional copies of this or other factsheets, contact:

1. Energy Resources Conservation Board
   Head office:
   640 - 5 Avenue SW
   Calgary, Alberta, T2P 3G4
   tel 297-8328

2. ERCB Field offices:

Bonnyville	tel	826-5352
Calgary (south)	tel	256-1474
Drayton Valley	tel	542-5182
Edmonton	tel	427-0200
Grande Prairie	tel	538-5138
Medicine Hat	tel	527-3385
Red Deer	tel	340-5454
Wainwright	tel	842-4431
Whitecourt	tel	778-3812

To call toll-free dial '0', ask for Zenith 22333, and then ask the RITE operator for the Alberta Government number you require.

October 1985